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THE ENGINEERING AND MINING JOURNAL.

RICHARD P. ROTHWELL, C. E., M. E.
ROSSITER W. RAYMOND, Ph. D. } Editors.

NOTE.—Communications relative to the editorial management should be addressed to Mr. ROTHWELL. The articles written by Mr. Raymond will be signed with a star.

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THE index to Volume XXI. to the ENGINEERING AND MINING JOURNAL, will be issued next week. Those desiring it can have the volume handsomely bound in half morocco and cloth, ($2.00) by sending their numbers to this office.

Our second article on the Hydraulic Machinery at the Philadelphia Exhibition, has been crowded out this week.

LECTURES ON MINING.

WE commence this week the publication of a course of some sixty lectures on Mining, delivered at the Royal School of Mines, London, by Prof. WARRINGTON W. SMYTH, one of the best informed of English Mining Engineers. This series of articles will run through the current volume of the ENGINEERING AND MINING JOURNAL, and those who desire this, and are not already subscribers, should make early application, for we frequently find it impossible to supply back numbers.

No systematic course of lectures on mining has yet been published in this country. Prof. SMYTH'S comprehensive views, and thorough practical familiarity with the subject, add great interest and value to his lectures; these will be fully illustrated wherever necessary, and will be perused with benefit by all engaged in mining, whether as engineers, superintendents, or as practical miners.

AMERICAN INSTITUTE OF MINING ENGINEERS.

CENTENNIAL MEETING.

PHILADELPHIA, June 20, 1876.

THE full account of the proceedings and excursions of the Philadelphia Meeting is unavoidably postponed to our next issue.

The following is the complete list of members and associates elected :

MEMBERS.

Allen, Charles F., 342 South Fourth Street, Cincinnati, O.
Boyd, Charles R., Wytheville, Va.
Brydges, Frederick H., Phœnixville, Pa.
Burden, I. Townsend, Troy, N. Y.
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Carson, James Patigrew, 80 Broadway, New York City.
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Clark, T. C., 410 Walnut Street, Phila.
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Clerc, F. L., Bethlehem Zinc Company, Bethlehem, Pa.
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Crowther, Benjamin, Sharpsburg, Allegheny County, Pa.
Daniels, Fred H., 8 West Street, Worcester, Mass.
Davis, O. W., Jr., Bangor, Maine.
Draper, Thomas W. M., New York City.
Edwards, J. Warner, Green Street Wharf, Philadelphia.
Ellsworth, A. M., San Francisco, Cal.
Faunce, G. B., Boston, Mass.
Fisher, Harvey, Duncannon, Perry County Pa.
Gell, John L., Jr, Pittsburg Car Wheel Works, Pittsburg, Pa.
Goodale, Charles F., Marlboro', Mass.
Gould, Robert H., East Cambridge, Mass.
Hall Edward J., 448 Franklin Street, Buffalo, N. Y.
Herr, H. B., Rosita, Colorado.
Hewitt, George C., Jenkintown, Montgomery County, Pa.
Hill, John W., Hamilton, Ohio.
Hunt, Alfred E., Hyde Park, Mass.
Inman, Alvin L., Crown Point, Essex County, N. Y.
James Samuel, Jr., Cambridgeport, Mass.
Kerr, Prof. Wm. C., Raleigh, North Carolina.
Knowles, Hon. L. I., Worcester, Mass.
Kŭdlich, Edgar, Drifton, Jeddo Post Office, Luzerne County, Pa.
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Leavitt, E. D., 2,131 Mount Vernon Street, Philadelphia.
Lee, Richard Henry, 1,525 Spruce Street, Philadelphia
Lockwood, G. P., Salt Lake City, Utah.
McKee, Wm. W., Philadelphia.
May, De Courcey, Baltimore, Md.
Merry, Henry, Negaunee, Marquette Co., Mich.
Patton, William Henry, Virginia City, Col.
Proctor, John R., Lexington, Kentucky.
Ramsey, Richard, Braidwood, Will Co., Ill.
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Robinson, Thomas W., Chicago, Ill.
Roe, G. G., Port Henry, Essex County New York.
Roe, L. H., Port Henry, Essex County, New York.
Schwarz, Theodore E., 157 Charles Street, Boston, Mass.
Shaler, Prof. N. S., Cambridge, Mass.
Shockley, W. H., New Bedford, Mass.
Smith, Philmore M., Syracuse, New York.
Snyder, John Fisher, Scranton, Pa.
Strauch, George B., Pottsville, Pa.
Sussman, Julius H., 42 Upton Street, Boston, Mass.
Sweet, John E., Ithaca, New York.
Thomas, James, Oxmoor, Jefferson Co., Ala.
Townsend, Walter D., Ward District, Boulder County, Col.
Whitehill, H. R., Carson City, Nevada.
Wild, Henry Tearing, Socorro. New Mexico
Wilson, John A., 410 Walnut Street, Phila.
Wilson, John L., 512 Marshall Street, Philadelphia.
Wrigley, Henry E., Titusville, Pa.

FOREIGN MEMBERS.

Althans, Ernst F., Oberbergrath, Breslau, Germany.
Kupelwieser, Professor Franz, Leoben, Austria.

ASSOCIATES.

Arnold, J. B., 44 Wood Street, Pittsburg.
Barros, Luiz de Souza, School of Mines, New York City.
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Denegre, Wm P., Troy, New York.
Emerson, B. F., Copper Falls, Keweenau County, Mich.
Fellows, Walter Allen, 3,939 Baring Street, Philadelphia.
Keep, Wm. J, 41 Seventh Street, Troy, New York.
Powel, John H., 3,336 Chestnut Street, Philadelphia.
Radford, W. H., School of Mines, New York City.
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Schwartz, J. E., 44 Wood Street, Pittsburg.
Willard, H. B., Port Henry, Essex County, New York.
Witherbee, Silas H., Port Henry, Essex County, New York.

CONVERSAZIONE OF THE INSTITUTE OF MINING ENGINEERS.

THE IRON ORES OF MISSOURI.

THE meeting of the Institute last week in Philadelphia made the réunion at the Centennial headquarters quite largely attended by the Mining Engineers on Thursday evening. Prof. R. PUMPELLY being called upon to make some remarks, said that as a number of our foreign visitors would be likely to visit Missouri this Summer, it would, perhaps, interest them to hear something of the iron ore deposits in that State. He said that two general kinds of ore were found in the State, hematite and limonite, some of the former of which was, undoubtedly, altered from magnetite.

These hematite ores always occur in porphyritic rock, the geological position of which has not, as yet, been definitely determined. By some it is considered to belong to Huronian, while others class it with the Laurentian rocks. Prof PUMPELLY described Pilot Knob as being a nearly circular hill, about 600 feet high, its structure being made up of massive porphyry and porphyry-conglomerates containing beds of specular iron ore.

The top of the knob is composed of a series of layers of porphyritic conglomerates, about 150 feet thick, below which occurs the main body of ore which is about forty feet thick. This ore bed is divided by a slate seam, which is from one to three feet thick.

The ore found above this slate seam is distinctly stratified and is not so rich as that found below. Underlying the ore are layers of clay schist followed by several varieties of jaspery and ordinary prophyry. The percentage of iron in these ores varies from 36 to 65 per cent., and the amount of phosphorus from 0·15 to 0·04 per cent. The silica varies from 6 to 15 per cent.

The Iron Mountain deposits of hematite ore differ from those of Pilot Knob in the method of their occurrence. They are found in veins and detached masses, disseminated through porphyritic rock. When Iron Mountain was first discovered, it was thought to be a solid mass of ore from the fact that its whole surface and base was covered with large masses of almost pure ore. This surface ore has now been worked to such an extent that the probable way in which these masses were brought into their surface position is now known. It is thought that at one time the mountain was much higher than now and having the same composition as that which remains, the result has been a decomposition of the porphyritic material which has left behind the iron ore which it contained. The pre-silurian age of these deposits is clearly shown here where these detached ore masses are found embedded in the silurian rocks which surround the hill base. The ore which is found in the exterior masses is purer than that which is still embedded in the porphyry owing to the weathering-out of apatite crystals, the hexagonal cavities where they once were, frequently being noticeable in the ore.

Prof. PUMPELLY was followed by Mr. R. W. RAYMOND, who showed a chart illustrating the production of the various metals in the United States from 1825 to 1875. Mr. RAYMOND explained the causes which had produced the more important changes in this production.

MACHINERY DEPARTMENT.—CENTENNIAL EXHIBITION.

THE Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, through the kindness of the Centennial Commissioners, has opened a Reception Room at the north-western end of Machinery Hall for the use of its members and visitors from abroad, interested in the Mechanic Arts. The Institute cordially invites all who desire to do so, to visit their room, in which will be found files of the Journal of the Institute and other periodicals devoted to the Industrial Arts. The room is in charge of a Committee of Thirty members of the Institute, one or more of whom will be in attendance daily, during the Exhibition, to receive visitors and give any information they may desire in reference to the Exhibition.

The following objects of great historical interest have been placed in the room :

1. *Franklin's Electrical Machine.*—This instrument is doubtless the one used by the great philosopher in making his wonderful experiments in the science of electricity. Presented to the Institute by Dr. JOHN R. COXE.

2. *Oliver Evans' Steam Locomotive Engine.*—This interesting model is among the earliest known, having been built about 1804.

3. *Oliver Evans' High Pressure Steam Engine.*—This is the model of an engine built by O. EVANS, about 1804, and is described in GALLOWAY'S work on the Steam Engine, page 101.—London, 1827.

4. *Working Model of a Steam Engine* built by M. W. BALDWIN, and presented by him to the Institute, about 1832.

J. B. KNIGHT, Secretary.

INTERNATIONAL EXHIBITION OF 1876.

Special Report of the Engineering and Mining Journal.

ADMISSIONS FOR THE WEEK ENDING JUNE 27, 1876.

Date.		Paying Visitors.	Press, Complimentary, and Exhibitors.	Total Visitors.
Previously reported		833,522	401,453*	1,234,975*
June 21	37th Day	32,134	12,265	44,399
" 22	38th "	39,394	12,405	51,799
" 23	39th "	27,695	11,698	39,393
" 24	40th "	25,107	11,736	36,843
" 26	41st "	21,120	11,601	32,721
" 27	42d "	20,343	10,223	30,566
Totals		999,315	471,381	1,470,696

* We have included in this 12,000, being estimated number of Press, Complimentary, and Exhibitors admitted June 20th, and not returned in our last.

UNION CONSOLIDATED MINING COMPANY'S, (DUCKTOWN, TENN.,) COPPER MINES AND WORKS.

THE low price of Union Consolidated stock, which we have quoted for some time past at 1½ to 1⅝, and which is largely dealt in, in a speculative way, on our New York board, has long indicated "something wrong," either in the management of the company, or in the mines themselves.

We commend the following information, which is entirely trustworthy, to the attention of the stockholders and all others "whom it may concern." It is to the interest of all engaged in mining enterprises, that this class of investment should not be brought into disrepute by bad management, whether it be the outgrowth of ignorance, or of even more objectionable causes. In certain respects, the management of these important mines is open to criticism, and some departments of the business are conducted in a manner which should attract the attention of the stockholders, as it has long done that of engineers who have from time to time visited the works.

CHATTANOOGA, Tenn.

TO THE EDITOR: SIR—Returning from a flying trip to North Carolina, I visited the old mining center of Ducktown, in Polk County, Tenn. These mines, like many of our Western Districts, were once supposed to contain incalculable riches, and the possessors of a few shares of stock in any of the many enterprises that sprung up during the Ducktown Copper excitement, deemed themselves peculiarly fortunate.

Three parallel principal deposits of yellow sulphuret of copper, named respectively the East, Middle, and Western leads, are recognized in Ducktown. The strike of the ore bodies, here wrongly called "veins," is about 45° east of north, the dip varies from 45° to vertical. The course of the deposits is easily traced by enormous masses of gossan of red oxyde of iron derived from the oxidations of the underlying sulphurets. Immediately below the gossan, and directly above the sulphurets, the rich black oxides of copper, and minute crystals of the native metal are met with; and these very oxides have wrought the temporary ruin of the district. When the Ducktown mines were first discovered, the easily and cheaply mined and smelted black ores were the only ones sought for. Numerous companies built smelting works, and labored to pay interest on enormous capitals and large bonded indebtedness. Sometimes the struggle was short, as in the case of the Culchote Company, which bought not quite 200 acres for the trifle of $300,000, and could find neither ore nor vein. Oftener, as in the case of the Burra-Burra Company, the mines struggled nobly for existence against overwhelming odds.

However, finally, sooner or later, the rich black ores were exhausted, yellow ores, requiring systematic mining and expensive opening of new ground, alone remained; and one by one, slowly but surely, the companies succumbed, and fell a prey to the inevitable results of wild speculation. What might have been one of the most successful mining regions of the United States, now boasts of but three producing mines and one smelter, whilst the ruins of some six or seven smelting works, and the remains of many shafts and moldering stacks, disfigure the beauty of the hills.

The sole survivor of this indiscriminate slaughter of mining companies, is the Union Consolidated Mining Company of Tennessee, formed by the consolidation of the interests of ten or eleven mines. It is now working the Western Range of deposits at the Mary Mine. This range, I am told, has been proved at intervals over a length of five miles, and embraces the Callaway, Mary, and Polk County Mines. The deposit is about 60 feet wide, and consists entirely of magnetic pyrites and calc spar, containing a small percentage of copper. No quartz is visible, and I doubt if any silica could be detected by analysis. The middle range, consisting of the Isabella, Eureka, Hiwassee, Tennessee, Cherokee, and Mobile Mines, is not at present worked; if we except the cement copper production from the waters of the Eureka. I was informed that on the Isabella property the deposit was proved by the diamond drill to a width of over 300 feet, and a foot-wall had yet to be encountered.

The ores of this range are identical with those of the Western Range, but are said to contain less copper.

The Eastern Range, embracing the East Tennessee, Loudon, and Burra-Burra properties, presents a crevice varying in width from 10 to 20 feet. The ores are ye low sulphurets, but the gangue differs widely from that of the foregoing ranges, and is always highly silicious. Thus at the East Tennessee Mine the gangue is a quartzose slate, at the Loudon, quartz and some mundic, and on the Burra property considerable hornblende is met with.

The yellow ores from this range are the only ores in the district which contain sufficient silica to smelt freely, and hence are proportionately valuable. Their value is further increased by the ability to dress the ores, which process is inapplicable to the large mass of the low grade ores derived from the middle and eastern range.

Of the three mines now being worked, the East Tennessee and Mary are owned by the Union Consolidated Company, and are opened by shafts respectively, 200 and 500 feet deep. The method of extraction pursued is underhand stoping, and the general character of the work bears a striking resemblance to the working of Cornish mines of a quarter of a century ago.

"Time" is certainly not considered of value in Ducktown. Thus at the East Tennessee Mine the main shaft was being sunk, and the rate of progress achieved was twelve feet per month! This mine, by the way, had not a single level opened, all the ore being derived from its only stope in the lowest level. I was told that a winze had been sunk, and proved good ore below, and the main shaft was being sunk to raise this ore body. If such are the facts of the case, it is surprising to see no steps taken to facilitate the sinking by any of the approved means now at the command of mining engineers. Even a novice can observe that the mine in its present condition does not pay. Why, then, in this age of steam, does not the company introduce a system of shaft-sinking and opening of new ground, more in accord with the methods pursued elsewhere with advantage? An unaccountable conservative spirit is plainly visible in the whole working of Ducktown mines. Secluded and far from the railroads, the mines are to-day worked as they were twenty years ago, and progress has shunned the door where it would have been an unwelcome guest.

The water of the Eastern Tennessee Mine (not sufficient to fill a three-inch pipe) is raised by a ponderous Cornish pump, having two lifts, balance bob, pump rods, etc., all set in motion by an engine consuming sufficient steam to run at least three direct acting steam pumps, each one capable of keeping the mine free of water. The hoisting is done by one of BACON & COPELAND'S hoist engines. These engines are undoubtedly excellent for light work, but their construction is not such as to recommend them for the large size required at Ducktown.

At the Mary Mine, preparations were being made to put in another unwieldly pump, to be connected by gearing with the hoist engine. This engine is built to reverse, and pumps, pump rods, gearing, fly wheel, etc., are all to be reversed with the engine every time the unbalanced cage is raised or lowered. This engine is noteworthy, as an example, how wasteful in the use of fuel an engine may be made, through no fault of its own. The dressing works owned by the Union Consolidated Company are three in number, and are well arranged in at least one instance, viz., that of the Mary Mine. The list of machinery at these works comprises a new pattern Blake's crusher, revolving screen and revolving picking table, a self-feeding 600 pound ten-stamp battery, from which the pulp flows into a "Rittinger" grading box of three compartments, which in turn feeds two continuous fine grained jigs, and one continuous revolving buddle. All the machinery is systematically arranged, and feeds and discharges automatically. The power is derived from a turbine wheel with an ample head and supply of water. The Isabella Dressing Works, built several years previous to the erection of the Mary Works, contain the same class of machinery as the Mary, but the handling of the stamp rock is poorly arranged, and must be quite costly. The East Tennessee Dressing Works, an old wooden-stamp Cornish establishment, is now out of use.

During my visit the Isabella Works only were kept supplied with rock; the Mary and East Tennessee Works being idle. The Isabella Smelting Works, the only smelter now in operation in the district, is connected with the Mary and East Tennessee Mines by a narrow gauge railroad. The works are systematically built, the furnaces being located on both sides of a little valley, the bottom between being occupied by roast-piles. The smelting process, as carried out, included the following operations:

1st. Roasting the ore.
2d. Smelting for first matte.
3d. Roasting the first matte.
4th. Smelting for second matte and black copper.
5th. Smelting for blister copper.
6th. Refining.

The roasting of the ores and first matte is carried out in piles of 500 and of 50 tons respectively.

The material to be roasted was thrown on a bed of cordwood laid on a stamped clay floor, and fire applied to the corners of the pile. The roasting of the ores is conducted in the open air, which must entail considerable loss by leaching. In fact green pools of water collecting about the roast yard after a heavy rain bore ample witness to this fact. The ore and matte smelting was carried out in small square furnaces about twelve feet high. Two tuyere holes are placed in the back wall, and the furnaces blown with noses. Of course the only fuel available is charcoal. A "Pilz" furnace which was tried a year ago gave poor results owing to the rapid accumulation of iron sows in its crucible. This furnace is now being repaired and fitted with water tuyeres, and will shortly be blown in on matte, and will be the first trial of water tuyeres in this section. The experiment is certainly worthy of the trial the intelligent managers are willing to give it.

The blowing cylinders, producing the wind for the shaft furnaces, are placed in a vertical frame and a horizontal steam engine geared to their crank shaft. No attention seems to have been paid to economy in the use of steam and fuel in the building of these engines, nor in fact in any of the steam machinery in use about Ducktown. But this is by no means an isolated instance in American metallurgy and mining. Many of our Western mills waste even more fuel and money by cheap (?) steam machinery. If Northern mills and furnaces find it profitable to buy costly compound or high expansion condensing engines with fuel comparatively cheap, the same course of reasoning must apply with still greater force to mining districts depending on expensive cordwood as its only fuel.

The blister and refining furnaces are reverberatories, fitted with a gas generator instead of a grate, and all connected by underground flues with one stack. The furnaces are well built in every respect and seem to give excellent results. They are lined with soapstone, and the arch is built of the same material. The soapstone, locally termed cotton rock, answers every purpose and is far superior to the best fire-brick.

The bottom of the furnaces are, as usual, built up of layers of beaten sand and slag. In the blister furnaces blast is made use of to facilitate the operation. As soon as the matte and black copper are molten an iron nozzle is introduced through a side door, and the blast directed on the surface of the liquid mass. Heavy fumes escaping from the stack of the furnace are the best evidence of the success of this method.

In the refining furnace no blast is used The refined metal is ladled into copper molds, which are a great improvement on the old cast iron pattern, are far less costly and prevent spitting of the metal.

The smelting processes are, on the whole, well carried out, and experience has undoubtedly suggested any deviations from the usual course. Most of the modern improvements have been given a fair test, or are to be tested, and if the company would inaugurate a similar policy in its mines, it would have a bright future, and financial success would be reasonably certain.

On the hill above the Isabella smelter and on the Eureka property Mr. J. E. RAHT is preparing to "leach" copper ores from the Loudon Mine, likewise owned by him. The mine water from the Eureka, to which reference has been made before, contains, in addition to salts of copper, a considerable quantity of free sulphuric acid, and this water is to be employed in leaching the roasted Loudon ores. Only the poor ores from the mine are to be thus treated, the rich yellow and black ores are at present accumulated for shipment or to wait the erection of a smelter.

By the by, Mr. ROBT. RAHT, and the Union Consolidation Company, of which company this gentleman was superintendent to within a very recent period, are at present engaged in a law-suit, which has every prospect of furnishing the legal fraternity with plenty of time and room to display their talents, and will, of course, impoverish the company. It seems Mr. RAHT, as agent, had the privilege of keeping a store on the company's premises. This business seems to have been a very lucrative one, if common report is to be believed, and Mr. RAHT was naturally desirous of continuing it. When the company failed one year to meet its expenses, he kindly furnished them with the sinews of war wherewith to proceed. This money not being forthcoming after awhile, Mr. RAHT took steps to attach the property. The company promptly took up the sponge and filed a cross bill for the snug little sum of $1,250,000, to which extent they accuse their former superintendent to have profited, by running the mines and smelter in the interest of his store. And thus the war waxes hot and the lawyers get their fees. If the company and Mr. RAHT would listen to sound advice, they would adjust their difficulty amicably, and spend the money now likey to go to the lawyers in building a railroad to connect the district with the coalfields. The Ducktown copper deposits contain every element of success, and a great mining center can here be created, proving a boon to this mountain country, and if the mines are properly managed, and cheap fuel and transportation assured, a very profitable investment for capitalists.

R.

AMERICAN IRON BRIDGES.*

By Thomas C. Clarke, Member of the Institution of Civil Engineers, of the American and Society of Civil Engineers, etc.

SOME philosopher has said that *results* come from internal impulses modified by external conditions. Applying this to European bridges, we find that the internal impulse is *first* to make as strong and as safe and as durable a structure as possible, and that the question of cost holds a secondary place. The external conditions are, plenty of time and rivers of comparatively uniform regimen, so that there is but little danger of scaffoldings being washed out by floods during erection.

Hence we find, consecutively—stone arches; cast iron arches; plate girders; and, finally, lattice girders of plates and angles rivetted together, copying the proportions already established for plate girders.

In this country, on the other hand, the internal impulse is to build the bridge (and in fact everything else), in as short a time as possible, and for the least possible sum. Hence our railway bridges were originally made of the most abundant and cheapest material—wood; and so designed as to be put together with the utmost rapidity, inasmuch as our rivers are subject to sudden and heavy freshets, and it never is safe to trust the bridge long supported by staging which may be washed out in a night. Hence, when we began to build our iron bridges, we copied the proportions already established as most economical in wooden trusses, and instead of rivetting the several parts together on the scaffolds, we adopted the use of tenons and sliding-joints for the compressive members, and of pins and eye bars for those in tension, which enables us to erect our bridges, without fitting, very rapidly.

Having begun in this path, we have seen no reason to depart from it. We find that great economy of material (which simply means little dead weight), is got by concentrating the iron along the lines of strain, by making long panels (which means few parts), and by proportioning our girders of a depth of never less and often more than one-eighth of their span. The form of truss now almost universally adopted, and which (by a process of natural selection) has almost driven out of use the Bollman, Fink, and Triangular girders, is the Quadrangular girder with vertical posts, and main tie bars inclined at an angle as nearly 45° as possible. This has the merit of subjecting the iron to strains in one direction only—either tension or compression, and if we agree with Herr WÖHLER that iron strained both ways is as highly strained as if the tension and compression were added together—this is a point of no small importance. We prefer to hang our cross floor beams from the pin, because then the load is transferred directly by the diagonal tie bars, without any bending moment.

Our peculiar web system allows us to give great height to our trusses, sufficient to enable us to put in vertical transverse bracing high enough to clear the smoke-stacks of the locomotives, which, we think, adds much to the lateral stiffness of our bridges.

The usual practice of American engineers is to provide, in addition to the weight of the structure itself, for a general rolling load of 4,000 lb. per foot for spans of 50 feet and below; 50 to 100, 3,000 lb.; 100 to 150, 2,750 lb.; 150 to 250, 2,500 lb.; 250 to 300, 2,250 lb.; above 300 lb., 2,000. In addition to this, the floor and panel system is strengthened to provide for a load arising from the concentrated weight of the engine of 3,500 and sometimes 4,000 lb. per foot lineal. Strains in tension are taken at 10,000 lb. per square inch, and in compressions 8,000 to 10,000 for chords of 10 to 14 diameters, and 4,000 to 6,000 for posts of 20 to 30 diameters.

So much for the design of our bridges. When we come to examine the methods of construction we shall see that the marked feature is the use of special machine tools, by which the sizes and lengths of all the parts are fitted with the utmost exactness at the place of manufacture. The ends of the upper chords and of the columns are faced in lathes; and the lower chord bars and diagonal tie bars are drilled with a pair of drills set on a wrought iron bed, so as to give absolute accuracy of length. The pins are turned and fill the holes so well that 1-100 of an inch is the limit of end allowed.

Now the point to which I particularly wish to call your attention is that when once the machinery is provided this accuracy of workmanship costs nothing. Hence there can be no disposition to slight work and make imperfect joints and bearings. The process of manufacture is the best inspection possible. The bridge is calculated to come to a certain camber, and if it does not come to that camber, or if any of the eye bars are loose something must be wrong.

Now, every one who has ever built riveted lattice bridges knows that unless iron templates are used and the greatest possible care taken in laying out the work that the rivet holes will not come opposite to each other, and either drifting or rimming must be allowed. Exactness of workmanship *can* be attained, but it costs the maker a great deal more money than rough fitting, while in the machine made bridges there is no inducement to do poor work.

As to the actual economy of material, perhaps the best illustration that I can give you is to quote the weights of the 200 feet spans over the Minamadic River, on the Intercolonial Railway of Canada, a picture of which hangs on the west gallery of the Main Building. Tenders were received for these bridges from various European, English, and American bridge builders. There were 17 spans of uniform length and these were all designed on the same specification, viz., to carry a general moving load of 2,800 lb. per lineal foot, and a load on floor system of 3,600 lb. per foot; strains in tensions 10,000 lb. per square inch; in compression, on chords 7,500 to 8,000 lb. per square inch, or posts 4,000 to 6,000 lb.

The different designs may be divided for purposes of comparison into four classes:

1. Riveted lattice girders, short panels, 6 to 8 ft. long; low trusses, 16 to 18 ft. high; weights, 244½, 221, 206½, 202 tons.

2. Riveted lattice girders, panels, 9 to 10½ ft. long; trusses, 20 ft. high; weights, 141, 140, 137, 144½ tons.

3. Pin connected trusses, panels, 9 to 11 ft.; trusses, 20 to 22 ft.; weights, 128½, 126½, 122 tons.

4. Pin connected trusses, panels 12 to 14 ft. long; trusses, 25 to 28 ft. high; weights, 111, 109½, 102 tons.

It will be observed that the saving of dead weight is due more to the design than to the difference between riveted and pin connections. We may say roughly that the difference due to this cause alone, is nothing for spans of under 100 ft.; from 100 to 200, 5 to 20 per cent. Above 200, the increase is rapid in favor of pin connections.

When we come to examine the question of rapidity of erection, the pin connections have a great advantage. They can not only be built much quicker, but they require no skilled labor; any ordinarily intelligent laborers can erect them, under a good foreman. Those of my hearers who have had the opening of their lines delayed by a strike of the riveters, can appreciate this point.

Spans up to 150 feet can be erected by a gang of 20 men, in a single day, if necessary; a 200-feet span, two to three days; a 250, three to four, etc.

As we put a less quantity of iron in our bridges, we are able to use a better quality. In fact, it is difficult to make the eye bars, forged by hydraulic pressure, except out of a good quality of iron. All the iron used for the tensile members of the bridge at Phœnixville is made as follows:

They take a high quality of gray forge pig iron, and work it in a furnace by the process technically known as "boiling," the boiling furnace being "fettled" with ore. This pig iron when "brought to nature" is balled up in the furnace in the usual way, squeezed in a Burden squeezer, and then rolled into a flat bar, technically known as "muck bar," or No. 1 bar.

From each heat so made one bar is taken and bent to an angle of 45 degrees cold; if it stands without any signs of fracture the heat is passed as good, if not, it is rejected.

The iron that has passed this test is piled, charged in a heating furnace, heated and rolled into flat bars. This is called No. 2 bar, and is sold as "Phœnix Best." The iron so rolled is again cut, piled, and rolled into the finished bar, and is called No. 3 bar, and is the iron sold by the Phœnix Iron Co. as "Phœnix Best Best." A bar of this iron, 2⅜ inches diameter, has been bent cold so that the sides came in close contact without showing the least signs of fracture.

It should be borne in mind that the object of re-working iron is to refine it by getting rid of the surplus cinder and scoria, making the iron firm in texture and of a more uniform quality. This uniformity of quality results from the fact that the pile from which a bar of No. 2 is made consists of fourteen No. 1 bars, and the pile of No. 3 of eight No. 2, so that if by chance an inferior muck bar had been used, it would form but 1-112 part of the No. 3, or "Best Best" bar.

All iron improves up to the third working, but if the quality of the pig is not suitable no amount of working will make the product good iron; hence the necessity for tests as to toughness and stretching.

The specification is as follows:

A round bar, 1½ inches diameter, by 12 inches long; ultimate strength, 55 000 to 60,000 lb. per sq. in.; no permanent set under 25,000 to 30,000; reduction of area at breaking point, 25 per cent.; elongation, 15 per cent.; cold bend from 90 to 180 degrees; but it always does much better than this, as in the instance of the 2⅜ bar quoted above.

The rule adopted for pins and eyes, is to make the pin diameter about four-fifths of the depth of flat bar, or one and one-third the diameter of round or square bar. The eye has from 50 to 66 per cent. of excess of area of metal over body of bar, and the thickness of flat bars is never made less than one-quarter of the depth.

Some fear has been expressed by those more familiar with riveted than with pin construction, lest the pins might become worn away by use. There is not the slightest danger, provided the pressure of bearing surfaces does not exceed, say 10,000 lb. per square inch, with the accurate workmanship of our pins turned from cold rolled shafting, and eye bars drilled to a 1-100 of an inch. Wear is simply impossible. But even with very rough workmanship, where the above limit of pressure is not exceeded, the wear is but slight.

One more point, and I have done. In Europe I believe that the practice is to receive tenders by the pound upon detailed drawings.

In the United States the engineer makes a general specification, giving the lengths of spans, width, angle of skew if any, the loads the bridge must be designed to carry, and the limit of allowed strains, leaving all details of construction and arrangement of depth, length of panels, etc., to be determined by those competing.

Different engineers, either connected with bridge establishments, or acting independently, but all following that branch as a specialty, make plans in accordance with the specifications, and tender so much per foot or per span keeping the weights to themselves. These methods have their advantages and corresponding disadvantages.

The European method, while securing plenty of iron, and safety in construction, has overloaded its bridges with dead weight, and made very long spans unattainable except at great cost, from there being no competition in design.

The American method, has up to this time secured both a safe and an economical use of material, and good quality of iron and workmanship. This has been due directly to competition in design.

But, as prices fall, the tendency is to economize material too much, particularly in short spans, which ought relatively to be stronger than long spans, which are strained chiefly by dead loads. The next step will be to use an inferior quality of iron, unless this is prevented by rigid inspection, or, as in the buying of locomotives, purchasers trust in a great measure to the reputation of the large establishments, which is too valuable to be sacrificed for a few tons of iron.

Where this guarantee is not attended to, as in the case of county road bridges, which are almost always let to the lowest bidder, entirely irrespective of skill or reputation, the most disastrous results follow. If a county road bridge will stand up until it is paid for, it is considered a good bridge. It is said, that the elephants who travel with menageries, when they encounter an iron road bridge, cannot be prevailed upon to even try to cross it. A wooden bridge they will condescend to examine, and if it seems firm, they will sometimes go over it. But when they see an iron bridge, they take for the river, and argument is in vain.

* Read at a Conversazione of the American Institute of Mining Engineers, 1100 Girard Street, Philadelphia, June 8, 1876.

TRINIDAD COAL.—Messrs. ENSMINGER & DAVIS have thoroughly tested the car load of coke purchased by them from the El Moro Coal and Coke Company of Trinidad, Colorado, having used two blasts in their foundry, using the same amount to the 100 pounds of metal that is usual when Pennsylvania coke is used, and pronounce it fully equal to the latter in every respect, the results being entirely satisfactory.

METALLIC OSMIUM.—At the session of the Academy of Sciences on the 8th of May, were exhibited several specimens of metallic osmium, prepared by M. HENRI STE.-CLAIRE DEVILLE. This osmium is of a blue shade, tinged with grey, showing violet if light is reflected several times upon its surface. Osmium is stated to be the most dense matter known; it is hard enough to scratch glass easily. In the preparation of crystallized osmium the vapor of osmic acid several times distilled is passed over pure carbon. To get this, benzine vapor is decomposed by causing it to pass over a tube of red porcelain, upon which coherent carbon is deposited as a hollow cylinder. The osmic acid vapor is afterwards introduced, carried in by nitrogen. The osmic acid is reduced, giving carbonic acid and osmium, which soon lines the inside of the carbon cylinder, ending by completely transforming the latter into carbonic acid, and depositing the metal. Tubes of osmium are thus produced of a nature analogous to the cadmies of oxide of zinc obtained by burning zinc vapors issuing from a hole in the cover of a crucible in which zinc is boiling.

ABSTRACTS OF LECTURES ON MINING.—No. I.

By Prof. W. W. Smyth, M.A., F.R.S., School of Mines, London.

(From the London "Mining Journal.")

A COURSE of sixty lectures on "Mining" in connection with the Royal School of Mines, by Prof. W. W. SMYTH, M.A., F.R.S., was commenced on Monday, November 8, 1875, the lectures being delivered in the theater of the Geological Museum, Jermyn Street, London. The substance of the first lecture was as follows:

It is my duty to-day to commence a course of lectures on a subject which commands our attention, on the one hand from its very high importance in a commercial point of view, especially in this country; and, secondly, because of its intimate connection with a number of sciences with which we cannot fail to be more or less interested. With regard to its commercial importance, I need only remind you of the very large number of people engaged in our mines, and of the enormous sums which represent the values of substances raised. From the excellent tables compiled by Mr. R. HUNT we find that the total value has risen from about £30,000,000 a few years ago to £59,000,000 in 1873, and that upwards of 120,000,000 tons of coal are raised in this country in a year.

The art of mining may be said to comprise those processes by which the useful minerals are obtained from their natural localities, these localities generally being underground, sometimes actually at the surface, sometimes at great depths below the surface. We might say the art of mining consists in the working of mines, but in most languages there has been an ambiguity as to the meaning of the word "mine." For example, the word "metallum" of the Middle Ages meant sometimes a metal, sometimes the locality from which it was obtained. In this country the word "mine" has different meanings in different parts; thus the term in Lancashire is commonly applied to a seam or bed of coal; in Scotland it signifies the underground level or gallery driven through the rock from one seam of coal to another. A "mine," according to the results of many legal actions, is defined generally as a working in which the men have to be lighted at their work by artificial light, while quarries, etc., open to the light of day, are not included under that term. In South Wales the term "mine" means the ironstone of the coal measures, whilst in the Forest of Dean the same term applies to the brown hematite of that district.

If we next look at the sciences which must be called in as auxiliaries we shall find that the ones specially concerned are geology, mineralogy, mechanics, and physics. Mineralogy treats not only of the minerals worked, but of the substances associated with them; geology takes notes of the places in which the useful minerals are likely to be found; mechanics deals with the apparatus and appliances which should be brought into play; and physics enables us to deal properly and scientifically with the solution of those questions which arise in the course of our operations—from water, for the requirements of ventilation, and so on. But an acquaintance with these sciences even in their entirety would not fit a man to be a miner; and so largely is this felt that in the selection of a man to manage a mine, they fly to the other extreme, and, dreading to take a person with the mere knowledge of science, take a workman who has learnt by rule of thumb to meet successfully some of the difficulties I have referred to. The application of science can only be properly brought into play by the light of actual experience in the mine. The real value of reading books and hearing lectures is that it may greatly abbreviate the time required for getting that experience; and the main purpose of our preliminary studies is to make us acquainted with what is carried out in different districts and under different circumstances, and to refer to their departments the different processes we shall have to examine.

There is no subject of human experience which would offer a more interesting subject for a series of historical lectures than mining; in the progress of civilization it has passed through some very remarkable changes. We may roughly divide its history into three periods. First, that of ancient times, of which we have accounts in such authors as PLINY, HERODOTUS, etc. Generally speaking, the works in that period were of small depth; in a great number of cases the rock was not difficult to deal with, and the substances extracted were of high intrinsic value; the labor of a large number of men could be obtained at a cheap rate, or, as in the mines of the Egyptians and those of Athens, large numbers of slaves were employed, and these, having no interest in the work, would take no pains to transfer their knowledge to the next generation. The second period is that of the Middle Ages, in which a very different state of things arose; the discovery of mines, especially the rich silver mines of Germany and Saxony, led to the entry into mining life of men of high intelligence and position, and they have left us some curious treatises and relics of workings, some of which were carried to very great depths; but amongst other things the bad state of the roads interfered with the conveyance of machinery from place to place.

The third period commenced with the advent of the steam-engine. Some of the deposits formerly easily worked have now become most difficult to deal with. The present state of the prices of materials as compared with the value of other commodities makes it extremely difficult to obtain a margin of profit, large quantities of materials have to be raised and great economy practised; that is to say in the great bulk of operations. Among the present disadvantages we must not overlook the suppression of individual energy due to the combination of men together in the Unions, and the results of the strikes caused by this fact have made it almost impossible in some districts to work mines with any degree of satisfaction It is owing to this, I think, that Great Britain has in the last few years received such a blow to its iron trade, about which we are in doubt as to when its effects will cease, if indeed they ever will. Among our advantages I may mention the introduction of machinery and steam, and the establishment of railways (long used in mines before applied to passenger traffic) and canals.

In this country the occupations of the coal miner and the metalliferous miner are held distinct, and hence you have a distinct class of persons occupying them. The cause of this is partly geographical and partly from the growth of these businesses in different centers, requiring men competent in one direction or the other. I think, on the whole, very considerable benefit accrues from it. In foreign countries, especially where there is a School of Mines—and what country now has not—the two subjects are treated more together; and to a large extent there is a great similarity between them. Thus, in both cases we have a more or less vertical shaft, with horizontal drifts; the nature of the pump and pumping-engines will be the same in both cases. I cannot quite say the same with respect to the winding-engines, but, at all events, the principles will be the same. In the one case the mineral lies in beds more or less horizontal; in the other the veins are more or less vertical in the rock. It may be stated, as a general rule, that it is desirable, even if we are going to follow practically only one branch, to know something of the methods of the other.

There is one other preliminary subject about which it is important that I should say a few words—the way in which the different minerals are held in different countries.

I shall have to say something about the other side of the Atlantic in the course of these lectures, but at present we may limit our attention to Europe. There is no doubt that when at first land was divided among conquerors and their chief officers, the minerals were retained for the service of the great bulk of the people, as represented by their leader or by their king; and hence we find that in some countries traces of this remain, while it has been in great part modified; in others the holding remains unaltered; this may be called the law of "royalty." In Austria, or France, or Germany, or Italy for instance, you have no right to commence working unless you apply to a certain Government officer, and have a certain district allotted to you. In England at one time this held good, and gold and silver are still called royal metals, but the others belong to the owners of the surface; this alteration came about the Middle Ages. A person in England can sell the land, but reserve to himself the right to enter and work the minerals underlying it. This is especially the case in the western districts. In France the same modification was made as in England until the time of the great revolution, when the right of minerals was again taken by the sovereign people; in such case it becomes necessary to train up a corps of engineers or qualified men—as at the École des Mines—to see that everything is carried on fairly and properly, and to look after the Government minerals. In Great Britain a relic of this is seen in the term "royalty," commonly applied to the portion of the mineral paid to the owner or lord of the soil; in other districts it is variously termed "dues," "duty," "rent," "free share," "dish." Persons who have been accustomed to the freedom enjoyed in England do not like the constant watching by the Government officers of these foreign countries when working there, being in some cases not merely watched and inspected, but also advised and instructed in various points.

We may say that under free conditions, as in England, there is more enterprise, more activity, but that there is too much thirsting after returns, and too little regard to the future; there is also that traffic in shares, which in some cases may have been useful to the mine, but in many cases has been productive of great mischief. Where there is that Government supervision there is less activity, but more prudent dealing with the stores, more looking towards the future, and spreading of the outlay over a great number of years. The great disadvantage of the English system is the limited period for which the land is let; usually there is a tack note of one, two, or three years for explorations, etc., to be made, then there is a lease for 21 years If the man were sure of coming down on the mineral at once there would be no great harm done, but in many cases it requires considerable time to develop the mineral. In the large coal mines in the North of England, where vast sums have to be spent in sinking, buildings, etc., the leases are for 31 years, in some cases even 60 or 90 years. In the gold digging and mining districts of North America and Australia, each man thinking he can find something has allotted to him a certain portion of land, 12 feet long, in which to operate; in the diamond diggings of South Africa 20 feet In Germany, in Yorkshire, and in Derbyshire we find some curious customs connected with the mines of those parts, some of them remaining in force still. A deal of curious and interesting information on the subject can be obtained from some legal works on the customs of Derbyshire.

Thus, in many of the old German, as in the Derbyshire mines, a large amount of the work was carried on in shallow workings. A man finding a spot of ground marked it, and had a right to work for a certain distance on each side; the measure was 7 fathoms, and this was laid midway across his spot, and then three measures on each side that were allotted to him. This piece was called the "Fundgrube" or *caput fordini*. Then a set of 7 fathoms was to be marked off for the king, another set for the queen, one for the cup-bearer, one for the master of the horse, one for the lord chamberlain, and so on, and after a certain distance the original finder came in again. In Derbyshire a man finding a metalliferous piece of ground applies to an officer called a barmaster, and then claims, with due formalities, the right to work in this ground for a certain distance; in each corner of his piece he places a small wooden structure, intended to represent a windlass, and it is felony to remove that landmark. All these cases, however, could only be applied to shallow workings, where the lode did not run far out of the vertical; when the works are required deeper, modifications must be introduced, as for the deeper stream works in Australia several men join together, each having so much frontage.

Not only may there be disadvantages attending a small area or set, but it may even be disadvantageous to have too large a set. Not long ago it was stated that a large French company failed, for this reason amongst others, that their area was too large, and they could not concentrate their operations. It is well for people to bear this in mind in considering the advertisements got up to catch the public, where the large area is often put forward as one of the advantages. The royalty used very frequently to be paid in kind—the king for instance taking a tithe of the dressed ore—in most cases money value has been substituted in coal and tonnage. The amount of royalty varies enormously in different districts; thus, whilst iron ore may in some cases bring, if of fair quality, a royalty of only 4d. per ton, there are many cases of the fine ores of the North of England where it rises to 18. 6d., 2s. 6d., or even 5s. For coal the tonnage will vary from 3d. in some cases, to 2s. 6d. in others. With metalliferous minerals the proportions are far more varied; in some rich districts of the North of England 1-5th is paid, in Central England 1-10th, or 1-12th is a common amount, while in more western districts it may fall to 1-18th, 1-20th, 1-30th, and in some cases even 1-60th, owing to the deeper workings and the more expensive processes of dressing required.

ZINC AS AN ANTI-INCRUSTATOR.—Messrs. O. BRUCKMANN & SONS, of Heilbronn, in a recent communication to the *Württembergische Gewerbeblatt* give most positive testimony regarding the efficiency of zinc as a preventive of the incrustation of steam boilers. They give the details of three trials of zinc scrap laid in the boiler, all of which were attended with the most favorable results under circumstances where every other means failed. As a result of their experience, they recommend the use of one kilogramme (2·2 pounds) of zinc scrap per month per horse-power; a quantity that would vary somewhat according to the quality of the water.

ACCIDENT AT THE SCRANTON STEEL WORKS.—An accident, which narrowly escaped being attended with fatal consequences, occurred on the 15th of June, at the Scranton Steel Works, where six men were severely burned by a splash of molten steel from the casting-pit. The serious affair took place during the process of transferring the metal from the ladle into one of the ingot-molds, and was similar in every respect to an accident by which seven men were injured at the same place a few days ago. The bottom of the mold into which the metal was poured happened to be damp, and the result was that the liquid steel recoiled with a flash, and leaping out of the mold scattered itself among the pitmen with terrible effect, scorching them about the bodies in a shocking manner.—*Scranton Republican.*

MINERAL RESOURCES OF THE NORTH SHORE OF LAKE SUPERIOR, CANADA.

WHILE the *south shore* of Lake Superior has no equal as a copper and iron producing region, the *north shore* bids fair to equal it in the production of gold and silver, at the same time the show for copper, iron, and lead, if not equal to that on South Shore, is not far from what that region was, when it was first discovered.

SILVER MINES.

The Silver Islet Mine, which is located on a small Island near Thunder Cape, has already produced between two and three million dollars of silver. There are several other silver mines being worked on Thunder Bay, Pie Island, and near Pyson River, which give encouraging assurances that they will develop into valuable producing mines.

The prospecting of this country, with one exception, has been confined to the Lake Shore and Islands adjacent to it, for the want of roads to reach the interior. Exceedingly rich veins, carrying gold and silver have been discovered on the Lake Shore to the eastward of Silver Islet. Professor CAMPBELL, who has examined many of them, says as soon as they are developed, they will astonish the world with their yield of gold and silver. He also says, arrangements are in progress to work them on an extensive scale.

JACKFISH LAKE AND SHEBANDOWAN GOLD DISTRICT.

This district lies about eighty miles to the north-west of Fort William, on Thunder Bay, and is reached by the Government overland turnpike road and steamer on the lake. The Canada Pacific Railroad, which is now building from Fort William to Lake Winnepeg, will run near the mines in this district. Experts who have examined this locality, regard it as by far the richest in that country—one well defined and exceedingly rich vein has been opened at several points, in which free gold has been found—some of the rock has been worked, and found to contain between $500 and $600 to the ton of gold and silver. One specimen of several pounds was broken out near the surface at one point on the vein, which was estimated to contain *twenty thousand dollars* to the ton of gold and silver. As this district is so easy of access, there seems little doubt but that it will soon develop some very valuable mines.

COPPER, IRON, AND LEAD.

Fine specimens of copper have been found at several points on the Lake Shore and Islands, but little has as yet been done in that direction, although the indications go to show that valuable deposits of that mineral will be found as the country is opened. Valuable deposits of iron ore and lead have also been discovered, which, when worked to their full capacity, must yield large returns.

This wonderful region is but in its infancy. Silver has been known to exist there for years, but the Canadians move in such matters so slowly, that nothing was done until recently, when the attention of some enterprising Yankees was called to it, and they have done something toward opening it up. The result is, that a large population is now settled at and around Thunder Bay, where operations with Duluth furnish business for three lines of first class Canadian steamers, which run between the lower lakes and that country.

With such rich mineral deposits, so easy of access by water from all parts of the country connected with our great lakes, and the early building of the eastern portion of the Canada Pacific Railroad from Lake Superior to Lake Winnepeg, we can see no reason why that country shall not soon develop into a wealth-producing region equal to some of those in the interior, and on the western part of the continent. T.

UTAH MINING NOTES.

Special Correspondence of the Engineering and Mining Journal.

TO THE EDITOR: SIR.—There have been but few important changes in our mining or smelting industries during the past two months. With the exception of the closing of the furnaces of the Flagstaff Silver Mining Company (Limited), the works which were running last winter are still in blast. The smelting of the ores in the southerly districts, in the neighborhood of Beaver and Star, is attracting much attention at present, and aside from the works established at Shauntic and Lincoln, four new plants are projected, also one for Pioche, Nev, for working the base metal ores of that district. An impetus has been given to both mining and smelting in the southern districts by reports that the Utah Southern Railroad would build their road south 150 miles during the present season. Such an extension would benefit both the road and the mines, since it would open up new mines and increase the amount of reight on the one hand, while reducing the cost of transportation so much, that ores which will not now bear the cost of working and shipment, would then pay well. Ores which will pay to ship 150 miles by wagon, are very scarce in Utah.

In the mines of the "Old Telegraph" Mining Company, in Bingham district, has been developed the largest body of lead ore ever discovered in Utah. The ore contains from 45 to 80 per cent. of lead, and from 12 to 23 oz. of silver per ton. They are now taking out about 100 tons per diem, which could readily be increased to 500 tons. These mines are netting the owners upward of $2,000 per diem. The Revere and Yosemite Mines, in Bingham, ship about 40 tons a day each.

In Cottonwood the mines are troubled very much by water, and the extraction of ores has been retarded. No new developments in regard to the Emma.

An effort was made by buyers to lower the prices on Cottonwood ores, and the best offer WALKER BROS. could get on a lot of good grade "Prince of Wales" was $1.10 per oz. Ag. on 35 per cent. Pb. They refused all bids, holding for better prices, and rates will advance again should the supply from Cottonwood not soon be increased.

In Dry Cañon most of the mines which pay or promise anything are being worked. The "Hidden Treasure" Company have completed their hoisting works and are now building a tram road to connect the mine with a new wagon road down the cañon. The "Chicago" Company are getting the hoisting works on the "Queen of the Hills" in place and, I hear, intend taking their Hallidie tramway from the Chicago Mine and putting it on the "Queen of the Hills."

The suit of the Magnolia vs. Mono Mine, wherein the plaintiffs asserted that the Mono was on their vein and asking possession, has been decided in favor of the Mono and the latter company will immediately apply for their patent. The Mono has been abominably worked, the object seeming to have been to get out all within easy reach and spend as little as possible. A good vein of rich ore is shown in the face of the bottom and easterly workings, and I believe that with proper management this mine will regain its position as the best paying thing in Utah.

In Stockton new developments prove that no one knew anything about it, since, contrary to general expectation, several good mines have been found there. The Southport leads at present, shipping 20 tons a day of ore assaying 50 to 70 per cent. Pb. and 20 to 35 ozs. Ag. During the month of May there were shipped:

169 cars bullion	3,551,341 lb.	Utah product alone.
5 " copper ore	100,986 lb.	
45 " lead ore	946,500 lb.	

During the month of April there were shipped:

149 cars bullion	3,129,401 lb.	Utah product alone.

SALT LAKE CITY, June 17, 1876. S. C.

COAL MINES AT POMEROY, OHIO.

THE mines of the Pomeroy Coal Company, five in number, viz., The Dabney, Peacock, Diamond, Minersville, and Excelsior are situated two hundred and twenty-five miles above Cincinnati. The Dabney has been in operation for forty years, and the Peacock for twenty-six. The mines are all opened out in the same seam, the Pittsburg seam or No. 8 of the Ohio Geological Survey. The coal is from four to five feet thick, the top coal about one foot three inches thick, inferior in quality, is separated by the "digger" from the bottom coal, and consumed at home in the manufacturing of salt. The mines are drift openings, and front on the river for a distance of three and one-half miles. At Minersville the water at its highest stages would flow back into the mine, if it was not prevented by putting in frame dams. The other four mines are from thirty to fifty feet above high water mark. The coal is easily won out, cropping on the river front and making a bold appearance, as in some cases the sandstone overlying the coal has been cut away until it shows a perpendicular front eighty feet high. The superincumbent strata overlying the coal at Pomeroy do not exceed in perpendicular thickness two hundred and sixty feet. The roof is of a gray shale from one to twenty feet thick, as a general thing it readily decomposes, and keeps falling and cutting itself up until it forms an arch or gains the sandstone, as the atmosphere is an active agent in decomposing the shale. This is especially the case in the entries that have been driven through the hills where a strong current of air sweeps through; we found that by putting doors upon the entries and admitting but a limited quantity of air to pass through, we prevented large quantities of slate from falling. In parts of the mine, as in the Excelsior, the shale has been cut out altogether and the sandstone forms the roof, and it is invariably true that where there is a sandstone roof, the coal is not so good in quality, it has more sulphur in it, and is more disturbed by horsebacks (faults) coming in both from the top and bottom, oftenest from the latter. These horsebacks begin in a point (or as the miners call it, "nothing"), and run out to a point; they vary from a few feet to one hundred feet in length, and from one to five feet thick, sometimes completely cutting out the coal. They run in a southeast and northwest direction, from seventy to eighty degrees. In the Peacock and Dabney they are of rare occurrence.

The greatest extent of the mines north from the entrance of the Peacock is five thousand two hundred and twenty-four feet, the most easterly point from the entrance, six thousand five hundred and seventy feet, and the most westerly from entrance eight thousand feet. The most distant point on the face of the coal or north in the Dabney Mine, from its entrance, is eight thousand one hundred and ninety-six feet, the most easterly point eight thousand five hundred feet, and westerly eight thousand seven hundred and sixty feet; these east and west points are taken from the entrance of the mouth of the mines. It is undoubtedly the Nelsonville Seam or No. 6 of the Ohio Geological Survey that lies from six hundred to six hundred and fifty feet below the Pomeroy Seam at this point, as has been proved by frequent borings made for salt water.

THOMAS MIDDLETON, Mining Engineer for the Pomeroy Coal Co.

NOTES ON GATING CASTINGS.

By Alfred E. Watkins, M. E.

IT is the practice in many foundries to pay little or no attention to the proper arrangement of gates, sprues, or rising heads, upon which the attainment of sound castings so much depends. Some little light upon this subject is the object of the present paper, and if ever so little information be thereby gained by those following a profession, about which there is so great a dearth in professional literature, the end of the writer will be attained.

GATES.

In shop nomenclature, all the passages leading the fluid metal *into* the mold are called "gates," each of which, however, has its own peculiar name, hence, the large opening into which the metal is first poured, is termed pouring gate. The recess below, or in connection with the pouring gate, for skimming the iron, is termed a skimming gate—the little passages from the skimming gate to the mold are sprue gates, usually "sprues" only—those openings by which the supply of iron is kept up after the casting is poured, are feeding gates, etc.

The form, size, number, and proper arrangement of either or all of these have a decided effect, one way or another, upon the soundness, and cleanness of the casting to which they appertain, and should be located and dimensioned with reference to the size, shape, and character of the work in hand.

POURING GATE.

The pouring gate being the principal entrance for the iron, we will discuss its merits first. When locating this, it must be so placed as to admit the metal to all parts of the mold at the same time, hence its position must be central, or as near central, as the nature of the work will permit.

Its cross section should be circular, for the reason, that this form presents the least refrigerating surface for a given area, hence, it is best to retain this form throughout as much of the length as possible, whatever they form at its juncture with the casting. There are cases where this form cannot be retained, especially in some classes of loam work; still it should not be deviated from, if at all possible. Narrow flat gates are of the worst possible form.

The proper diameter for gates of this class, should bear a certain ratio to the refrigerating surface of the mold. If they be too small, the casting will suffer, if too large, unless intended as *skimmers*, there is a useless expenditure of iron. To lay down an exact formula for this orifice, I am not prepared just now, through lack of sufficient experimental data. As iron in its melted state is but a fluid, it will necessarily follow the laws governing fluids; hence, the usual formula for ascertaining the diameter of pipes for a given discharge, will answer in this case also; a constant must, however, be included for each square foot of mold area or cooling surface, for, in the case of a stove plate, and a ball, each weighing one hundred pounds, it is at once apparent that the stove plate requires a much larger gate area than the ball; or the metal would

be so much impeded by its friction through the passage as to lose its heat, and run thick over the extensive surface presented by the one over that of the other. For small castings, probably little attention would be paid to formulæ if they did exist, but in castings of large sizes—loam work especially—its convenience would become at once apparent.

SKIMMING GATES.

For some classes of work it becomes necessary to be particular that none but clean iron enters the mould; to attain this end skimming gates are employed. The forms of these are various, yet, when the molder once understands the principle of their operation, his judgment and inventive genius will at once enable him to design any style that would be most likely to meet his particular case. The principles usually employed are those of specific gravity and centrifugal force.

To attain the end by employing the specific gravity principle, the pouring-gate is made of much larger area than would be necessary if it were to be employed as a pouring-gate only; the orifice at the juncture with the mold is not, however, increased above that required for the ordinary pouring-gate; the metal having filled the gate, the small orifice into the mold throttles down the flow, allowing *time* for the lighter material to separate from the iron, and ascend to the surface of the gate, where it will be found after the casting is poured.

The centrifugal force principle is employed by forming a chamber between the mold and pouring-gate, to both of which it is connected by small channels or "sprues." The shape of this chamber and arrangement of the sprues accomplish the whole end.

In one manner of employing this principle the chamber, or skimming-gate, is formed by molding a ball, equally in both cope and drag; the sprue from the pouring-gate is then led into it at a tangent, to the outer edge or circumference, the sprue to the mold is taken out radially from the axis (it is best to take the sprue to the mold out just back of the sprue from the pouring-gate, that the iron may travel around as much of the chamber, before it is drawn off, as possible). It becomes at once apparent that the metal entering from the pouring-gate is thrown violently against the walls of the chamber, which, from its shape imparts a rotary motion thereto, and the constant supply of metal causes the iron to take upon itself a rapid spinning motion, whereby the heavier body (iron) is thrown to the outside, where it is drawn off by the sprue, and the lighter body (dross) is forced to the center, where it revolves about the central axis.

It is, of course, necessary that all the sprues to the mold be taken out of the drag side of the flask, while those from the pouring-gate may be either in drag or cope. It is not necessary to lead only one sprue from the chamber to the mold—a number may be employed if the nature of the work require it. It *is* essential, however, to have the sprues to the mold of less area than those from the pouring-gate, that they may act as a check upon the fluid iron, and give *time* for the foreign matter to separate.

FEEDING GATES.

These are employed in large castings for the purpose of supplying iron taken up by the casting in shrinking. Their best position is undoubtedly over some thin portion of the casting likely to be injured by the shrinkage strains, because the hot iron being supplied to that point the longest will enable the strains caused by the rest of the mass in cooling to adjust themselves without injury to the weaker part.

More than one feeding gate to a casting is not necessary. I have noticed in some cases these gates strung along in a row like sentinels. This is all wrong, for the reason that for every gate added the feed is correspondingly slow, and the orifice more likely to chill up. To secure a clean gate it is necessary for the feed to be rapid, necessitating the constant supply of fresh hot iron. If, however, two gates be employed, the feed is only half as fast as with one, and the opening will chill up in half the time. If three gates be used the feed in each will be reduced to one-third and the difficulty of keeping the gates open will be enhanced three times, and so on for each additional gate, and when the gates are knocked off a blemish in the form of a shrinkage hole will be found at the root of each, owing to the chilling up of the gate before all the shrinkage had been supplied. This will not be so when one gate is used, for the reason that the gate remains open till the last possible shrinkage takes place, and there is no further tendency to strain after the gate has chilled. If a blemish of this sort does occur with one gate, it is because the feeding has not been properly attended to, and the metal allowed to get so cool before the hot iron was added that the end in view was defeated.

SHRINKAGE HOLES.

These usually occur beneath gates, and are explained by the walls of the gates chilling the mass contained therein before the mass of the casting had ceased shrinking. As the gate chilled from the sides and top it may be likened to a capped pillar, the central part strained away. The top of the gate being exposed to the atmosphere it will chill most rapidly from the top toward the bottom, therefore the softest mass will be that nearest the casting, and that part that will supply the shrinkage required by the casting; hence a *cavity* is the result.

ON THE HOT BLAST, WITH AN EXPLANATION OF ITS MODE OF ACTION IN IRON FURNACES OF DIFFERENT CAPACITIES.*

By I. Lowthian Bell, M.P., F.R.S.

THERE has been probably no improvement introduced into the manufacture of iron which created more surprise in the minds of practical smelters and of scientific men than NEILSEN'S discovery of the hot blast.

In 1829, Messrs. DUNLOP & Co. consumed at the Clyde Works, near Glasgow, nearly 7¾ tons of coal to make a ton of pig iron, of which about 20 cwt. was employed under the boilers of the blowing engines, leaving nearly seven tons for the consumption of the furnace itself. In the year 1833, by heating the air to 612° F. (322° C.), they reduced the 7¾ to 3 tons by the mere burning of 8 cwt. of coal in the apparatus for raising the blast to this temperature. The statement just given was strictly true in a commercial sense, but when we come to consider the question as one of physical science it is necessary to eliminate some of the conditions which conduced to so extraordinary a result.

Anterior to NEILSEN'S time the fuel employed in smelting iron was coke, and it was supposed at that period, erroneously, however, that coal in its raw state, when burned with cold air, was totally unfit for the purpose in question. This mineral, as it was obtained from the Lanarkshire coal-field, contained about 35 per cent. of volatile matter, but the process of charring it was performed in so unskillful a manner that instead of receiving 88 cwt. of coke from 135 cwt. of coal, 60 cwt. only was the product of the operation. Again, the reduced consumption of carbon in the furnace itself was accompanied by a corresponding diminution of blast, and this was followed by an economy of half a ton in engine coal. After making a proper allowance, however, for all these collateral circumstances, we are within the mark when we admit that in actual coke, which is really the form the fuel has to assume before it is burnt in the blast furnace, not less than 30 cwt. was saved by heating the blast to 615° F. (322° C.). This unexpected economy, be it remembered, was also obtained by the combustion of the 8 cwt. of coal, somewhat wastefully applied in the hot air apparatus.

Numerous have been the opinions advanced by different authorities in the scientific world to account for the apparent anomaly, but none, in my humble judgment, satisfactorily explains the mode of action of the hot blast. The object of this communication, therefore, is to present for your examination certain views which I have been led to adopt on this subject, after bestowing upon it some considerable attention.

Before proceeding to do this, I would ask you to review very briefly the nature of the process which is carried on in an iron furnace, whether it be fed with hot or with cold air.

In opposition to opinions formerly expressed by others, I ascertained during an extensive series of experiments, that oxide of iron was susceptible of reduction to the metallic state at temperatures far below that believed to be necessary. This was proved in a variety of ways. Oxide of iron obtained artificially, and as it exists in various ores, was exposed at known temperatures in the laboratory to currents of carbonic oxide as well as to mixtures of this gas with different proportions of carbonic acid, the latter substance, as is well known, being the product of the reduction. Secondly, the same substances were afterward placed in cavities in the blast furnace, so as to secure, as nearly as possible, a treatment analagous to that which they undergo in the actual process of smelting. Thirdly, the gases of different furnaces taken at different heights above the tuyeres were analyzed, by which means it was ascertained that when the combined oxygen they contained approached in quantity to that corresponding with the nitrogen as it is found in atmospheric air, the materials under treatment had, at certain points, ceased to give off any notable quantity of oxygen gas.

In a very few minutes, therefore, after the ore is shot into the throat, reduction begins, and in most cases by the time it has traveled downward through 12 or 15 feet this division of the process may be said to be completed. Below this level, omitting any chemical action connected with the formation of cyanogen salts, the value of height in a blast furnace must only be regarded as a means of intercepting the heat which is carried upward by the rapid current of gases generated by the combustion of the fuel at the tuyeres. These gases, immensely expanded by the high temperature prevailing in the hearth, arrive speedily at the point of exit, and in the event of the furnace being of insufficient height they carry with them, in the form of sensible heat, the useful effect of a considerable portion of the combustible employed in the operation.

This, however, is not the sum of the loss due to inadequate dimensions. Each equivalent of peroxide of iron (Fe_2O_3)—the usual compound of the metal as it exists in our ores—requires for its reduction three equivalents of carbon which may be presented either in its solid form, or as gaseous carbonic oxide. In the former case carbonic oxide, and in the latter, carbonic acid is the product of the reaction. In most cases it is the lower oxide of carbon, which is the immediate agent of reduction, but in the event of this operation taking place when the contents of the furnace are at a very high temperature, the carbonic acid so formed is brought back to the state of carbonic oxide, by meeting with highly incandescent carbon. In this way, to all intents, the heat evolved does not exceed that obtained by burning carbon direct to the condition of this last-named gas.

In addition to the source of carbonic acid just mentioned, there is a second one arising from the dissociation of carbonic oxide, two equivalents of which are split up by oxide of iron into one equivalent of carbon, and one of carbonic acid. It is equally important that this action should also be effected where the temperature does not suffice to reduce it to the state of carbonic oxide, in the manner already described.

By means of suitable openings in the sides of two furnaces, one of 48 and the other of 80 feet in height, I learned that in the lesser, by the time the materials had reached the depth of 12 feet from the top, they had attained a full red heat, whereas in the larger its contents did not acquire this temperature until they had descended to a distance of about 24 feet from the charging plates.

Repeated analyses of the gases as they left the furnace satisfied me that nearly the full equivalent of carbonic acid due to reduction, and to carbonic oxide dissociation, was to be found in those of the loftier furnace, whereas something like one-fifth of this higher oxide of carbon had disappeared in the other. When it is borne in mind that the heat generated by a unit of carbon burnt to carbonic acid, and of one burnt to carbonic oxide, is as 3·33 to 1, the great importance of avoiding using carbon directly in its solid form as the reducing agent, or of partially unburning the carbon acid, will at once be appreciated.

Until a dozen years ago the furnaces in general use rarely exceeded fifty feet in height; indeed, having regard to the imperceptible character of the advantage which ensued from any moderate addition to their capacity, it is not extraordinary that those iron-masters who added a yard or two only to the dimensions of their furnaces, should not have pursued any further alteration in the direction referred to.

About the period just spoken of, an experiment of a much bolder nature was tried by Messrs. BOLCKOW & VAUGHAN, at Middlesbrough, who raised one of theirs from 45 to 75 feet, retaining the original diameter of 15 or 16 feet in the boshes. Immediately afterward, still larger dimensions were adopted, and in process of time, the example of the North of England extended to some cold blast furnaces in Shropshire. The change was eminently satisfactory, for the saving in fuel proved almost exactly the same as had been accomplished by the use of hot air, to furnaces originally engaged in smelting, with cold air, the minerals in use in that locality.

Now, had the use of furnaces, 70 or 80 feet high, preceded NEILSEN'S invention, I do not think it would have occurred to us to have attributed the saving of coke to any mysterious peculiarity in the nature of the combustion which takes place at the tuyeres. Instead of propounding puzzling doctrines, as has been done, to account for the heat proceeding from a few hundredweights of coal burnt in the hot air apparatus, saving a much larger weight in the furnace, we would probably have sought to identify the mode of action of the hot blast furnace, with that of a mere addition of capacity.

I propose to show, in the first instance, how the substitution of heated for

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cold air, is equivalent to an increase in the capacity of a furnace, and then to follow this up by pointing out other circumstances, which, in my judgment, perform a supplementary part in raising the efficiency in a furnace using hot blast. Before attempting this, I would remark that in all cases the fuel employed in the smelting process must be considered as coke, the iron produced may be regarded as that known as No. 3, the air, it may be observed, was invariably heated by the waste gases from the operation. These were collected by hermetically closing the furnace by means of the arrangement known as the cup and cone. From repeated analyses of the gases from a 48-feet hot blast furnace, and by careful examination of the temperature of the air, I was led to conclude that out of every 100 heat units evolved in its interior, there was due to combustion of carbon, 86 units, and contributed by the blast 14 units.

So far then as an abstract question of volume of gas is concerned, 14 per cent., in the instance just quoted, is produced without any more vaporous matter escaping from the tunnel head, than if 86 units of heat had resulted from the combustion of carbon fed with air at 0° C. (32° F.). If, however, we propose to ourselves the problem, as to the increase of capacity required, to permit the flow of gases through the contents of a furnace to correspond with diminution due to the heat contributed by the blast, 7,000 cubic feet in one blown with cold air, ought to be equal to the duty performed in 6,000 cubic feet worked with hot blast. This is too small a margin to bring the consumption of coke per ton of iron to the same figure in each case; but as furnaces receiving air at a high temperature afford a much larger produce of the two, the economy of fuel cannot be said to accompany, in a ratable manner, the increase of useful capacity, when such increase is the consequence of diminution of the volume of gaseous matter passing through them.

If from any cause the relative proportions of coke, ore, and limestone are changed the power of the mixture to interrupt and return to the hearth the ascending heat of the gases is also modified at the same time. Experimentally it was shown that the materials used on the banks of the river Tees, possessed bulk for bulk the following cooling properties on gases passing through them at a temperature a little above that of melting zinc.

Coke taken as unity	1·00
Limestone	1·60
Calcined Cleveland iron-stone	2·00

From these figures it was estimated that the ordinary burden of a hot-blast furnace, possesses a heat-absorbing power about one-tenth superior to that of one blown with cold air, and by so much at least, is the useful capacity of the former raised by the change. We have then rushing upwards through the contents of the furnace an immense volume of highly-heated gas meeting a descending column of solid cooler material. In cases where these two currents are moving more slowly than in others, it might be imagined *à priori* that the gases would part with more of their heat and, as a natural consequence, that the consumption of fuel would be lessened. The very reverse, however, is the fact unless the rate of driving is in excess of the power of the structure. Circumstances arose at the Clarence Works which rendered it necessary for some weeks to slacken the quantity of blast received by six furnaces having a height of 48 ft. and a capacity of 6,000 cubic feet. The following shows the effect of the alteration:

Average make per week.	Average number of iron.	Cwts. coke.
Tons, 246 (normal speed of work.)	3·73	27·50
" 219	3·45	28·98
" 206	3·20	31·06
" 186	3·60	30·34

Within certain limits, therefore, the gases rise in temperature under such conditions as those just described. The heat carried out of the furnace represents so much loss and, more or less, the effect of the change manifests itself in the figures by an increase in the quantity of combustible required for the same duty.

The phenomenon just described I conceive to be due to the generation of heat which takes place in the reducing zone of the furnace which, in one of 48 feet in height, is consigned to a third or fourth of its upper part. Of the 86 units already referred to as evolved by the combustion of the fuel, fully one-third is due to the conversion of carbonic oxide to carbonic acid, which conversion is exclusively effected by the oxide of iron of the ore. It is true the escaping gases do not, by their temperature, indicate that so large a proportion of the heat developed by the combustion of the fuel is produced so near their point of exit. The absence of a corresponding amount of sensible heat in the gases is due to its absorption by the oxygen in its change from the solid to the gaseous form. The balance between these opposing tendencies is not considerable, and it being a doubtful, and at the same time an important matter, in a practical point of view, I made its investigation the subject of direct experiment on a large scale. The temperature of the gases escaping from a furnace was observed during a sufficiently long time to obtain a pretty close approximation to a correct average. The iron ore was then withdrawn and an equal weight of a mixture of blast furnace slag and flints was charged in its stead. During the use of these substances, inert so far as any chemical action between them and carbonic oxide is concerned, the average temperature of the gases fell about 100° C. (180° F.).

It will be shown hereafter that the circumstance of the upper region being a heat-evolving one, is of importance, because to it, in my opinion, is due the fact that after certain dimensions of furnaces are reached, no further cooling of the escaping gases ensues from their having to pass through an increased quantity of the solid material used in the process. Seeing that the mere cooling of the gases, due either to the size of the furnace, or to a diminution of their volume, as happens where heated air is employed, does not suffice to account for all the economy effected by pursuing either of these modes of working, we are led to consider whether the chemical conditions attending the process are not modified by the change, and modified in the same way in both cases, *i. e.*, when we raise the temperature of the blast, or increase the capacity of the furnace. The only phenomena of a purely chemical nature, necessary to be considered for our present purpose, is the reduction of the iron to its metallic state, and the behavior of the carbonic acid which accompanies this process.

The deoxidation of an ore of iron is of course a work of time, for the reducing gas has to penetrate into masses of greater or less magnitude. If, before it has done this in a perfect manner, the mineral reaches a zone of the furnace where the temperature enables the carbon of the fuel to attack the carbonic acid generated by the act of reduction, we have to submit to the loss already referred to. Should this reversed action take place, to the extent of one-half the carbonic acid due to the operation, a loss of about 20 per cent. of the heat required for the smelting of a ton of pig iron ensues.

The advantage, therefore, resulting from the use of a sufficiently lofty furnace is the adjustment of the temperatures of its different zones, so that the ore is reduced under circumstances where, so far as possible, this unburning, as it were, of carbonic acid, is avoided.

The same end is attained by diminishing the volume of gases attending the generation of a given amount of heat. This happens when the blast itself is raised in temperature, while the saving of furnace fuel is necessarily increased, by the heat of which the air is thus made the vehicle.

Before proceeding with proofs in support of the general correctness of the views just set forth, I would shortly direct attention to what has been assigned by older writers as the cause of a saving of fuel which could not of course be accounted for by the actual heat contained in the hot blast itself.

Practically, they all amounted to the same thing—an increased temperature in the zones of combustion and fusion, resulting from a more rapid burning of the fuel, or by avoiding the refrigerating effect of throwing a large body of cold air into the hottest part of the furnace. I may observe, in reference to this supposed change in the velocity with which the atmospheric oxygen combined with the carbon at the tuyeres, that, so far as I know, no analyses of the products of combustion have been adduced in justification of such a hypothesis.

The experience afforded by the SIEMENS regenerative furnace might appear to warrant the conclusion of an increased intensity of temperature by the preliminary heating of the blast. There is, however, no real analogy between heating the air for smelting iron and that required by SIEMENS, because in every cold-blast furnace the so-called "regenerative" principle is already in constant operation. The materials above the tuyeres in it, as they descend in a continuous stream, perform precisely the same office as that obtained from the brick cells of the regenerator. I have sought, upon different occasions, to learn to what extent the incoming solid contents of a blast-furnace acted in the manner just described. Immediately on blowing in, the temperature of the escaping gases was taken and observations on this point were continued until their mean heat became stationary. By estimating the total quantity produced by the coke, during the period in question, and deducting from it the heat, known to be absorbed by the performed duty, the difference was regarded as that retained by the materials. From the data thus procured it was estimated that, during any given time, of the heat actually available in the hearth, 70 per cent. was due to that previously generated and returned to the region of fusion by the current of solids during its descent.

Attending the supposed more rapid combustion at the tuyeres was an elevation of temperature which, in some unexplained way, had to operate beneficially in effecting the fusion of the pig iron. It appears to have been overlooked that the addition of more material, to be acted on by a given weight of coke, would tend to reduce the heat of the hearth of a hot-blast furnace to that of one blown with cold air. I maintain, however, that the grade of metal produced is of itself an unmistakable indication of the temperature at which the iron was melted, and which, from its intensity, it is difficult otherwise to measure. As is well known, the higher numbers of pig iron require during their manufacture a more intense heat than the lower; I was therefore led to conclude that if the lowest quality, *i.e.*, white iron, were exposed to a temperature sufficiently elevated, to produce gray metal, a corresponding alteration in its quality would follow. A bar of white pig was in consequence plunged into the current of cinder flowing from a furnace making No. 3 iron, the effect of which was to fuse the iron at a temperature closely resembling that required for the production of gray metal. After flowing down the runner, so as to bring the melted metal as nearly as possible to the same heat as the cinder, it was intercepted in a cavity scooped out in the channel for the purpose. The iron thus treated resembled almost exactly in quality that being smelted by the furnace where the experiment was tried. In the matter of mere temperature therefor, I think we may assume the quality of the pig as a fair index of the temperature of the hearth of any furnace whether it be blown with hot or with cold air.

It was moreover early remarked by manufacturers and others that the economy in fuel effected by the use of hot air, varied considerably with different ores smelted by its aid. With Scotch black-band the saving was not less than 30 cwt. of coke per ton of iron manufactured, whereas in Wales it did not much exceed one-third of this quantity, and again in France, furnaces were instanced where the change in quantity of combustible used, after heating the blast, was scarcely appreciable. Now, it is difficult to understand if the readier fusion of iron in a hot-blast furnace was productive of the great measure of economy in Scotland, why it should be almost entirely inoperative in France.

It has been my wish to explain that the establishment of a certain position of equilibrium in the furnace is productive of economy, because by it the reduction of the ore and consequent generation of carbonic acid is confined more or less to a zone where the heat does not permit this gas to be affected by the presence of carbon. If this be conceded then it is clear that if one ore part with its oxygen more readily than another, a furnace working the less refractory might have its desired position of equilibrium materially disturbed by the substitution of one requiring a much larger time for its reduction.

That different ores of iron do differ in susceptibility to reduction is conclusively established in actual practice as well as by the following experiment, in which the specimens were simultaneously exposed to a current of carbonic oxide, at a temperature of 410° C. (770° F.) during a period of six hours—

Unroasted specular ore of Elba lost of its oxygen	18.1 per cent.
A specimen of roasted Spathose ore	41·9 "
" " Cleveland stone	50·6 "
" unroasted Lancashire hematite	70·9 "

These figures point irresistably to the conclusion that a furnace just large enough for working satisfactorily with Lancashire ore would have its conditions materially affected for the worse by giving it the more refractory ironstone of North Yorkshire to smelt. We shall see hereafter that the red hematite can be advantageously smelted in a smaller furnace than happens with the oolitic-stone of Cleveland.

It must also be kept in view that as reduction proceeds very slowly at low temperatures it is essential that sufficient time should be afforded for this operation, before the ore reaches a depth in the furnace where carbon is dissolved by carbonic acid. The figures below show how rapidly reduction is impeded by a lowering of the temperature at which it is carried on, Cleveland calcined stone being in all cases the ore employed.

Temperature.	Loss per hour of original oxygen.
Bright red	18·94 per cent.
Red	7·87 "
145° C. (779° F.)	5 80 "
260-270° C. (500-530° F.)	1·31 "
221-238° C. (430-460° F.)	0·28 "

In the first constructed hot-blast furnaces the evils already referred to were mitigated but not entirely removed. The gases at their escape at a high tem-

perature and the reduction of carbonic acid back to the state of carbonic oxide were still the source of a considerable waste of fuel. The blast itself, from some prejudice in the minds of furnace managers, was also rarely if ever heated beyond the point where it was just able to melt lead.

About twenty years ago the Cleveland iron masters in the North of England raised the temperature of their blast to about 485° C. (905° F.) with considerable advantage in the matter of coke, and ten years later the large dimensions of Messrs. BOLCKOW & VAUGHAN'S furnace were added to considerably by other manufacturers, two at the Clarence Works being 80 feet high with boshes of 20 feet and a capacity of nearly 16,000 cubic feet. The saving in fuel from these two alterations may be approximately stated as 8 or 9 cwt., of which two-thirds was due to the enlargement of size.

These highly satisfactory results inspired some makers, with what at the time I regarded as rather extravagant ideas of what might be accomplished in the directions just named. One set of gentlemen was found recommending the use of blast heated to a couple of thousand degrees of Fahrenheit, another urged the adoption of furnaces containing 70,000 or 80,000 cubic feet, while a third did not hesitate to advocate the expediency of uniting this intense temperature in the heating stoves with enormous dimensions in the furnace, by which it was expected a ton of iron might be smelted from Cleveland ironstone with 13 or 14 cwt. of coke.

The substitution of firebrick for iron in the hot-air apparatus tended to encourage these hopes, inasmuch as the comparative indestructibility of the material employed, offered, it was considered, no hindrance to obtaining the blast even beyond the temperature already named. Furnaces at the same time were erected having in one case a height of 103 feet and a capacity of 33,000 feet, and in another 90 feet with boshes of 35 feet without any approach to the realization of expectations counted upon 7 or 8 years ago.

It has been stated upon different occasions by advocates of the use of intensely heated air, that we were justified in assigning to every addition of 100° to the blast the same saving as that effected by any other 100° which preceded it. This is manifestly an error, because, with each step in the diminution of the fuel consumed, there is a corresponding diminution in the quantity of air required, so that to carry the same amount of heat into the furnace, represented by the 100°, the blast must be raised progressively to a much higher point as the quantity of fuel and air are reduced in weight.

As an example, suppose the case of a furnace working with 22 cwt. of coke to the ton of its produce, by raising the blast 96° C. (173° F.) we might, so far as a question of heat is concerned, reduce this coke by one cwt., but to reduce the coke from 16 cwt. to 15 cwt., the blast would have to receive an addition of 201° C. (362° F.) to its temperature. The consequence of this is, that to command the quantity of heat considered as being necessary for smelting a ton of iron in Cleveland, the air would have to be delivered into the furnace at a temperature of something like 1,300° to 1,400° C. (2,372° to 2,552° F.) to enable us to obtain it with 15 cwt. of coke.

Notwithstanding the durable nature of the firebrick stove, it is questionable whether, unless with an enormous plant, blast of this temperature could be supplied with regularity and constantly, owing to the slowness compared with iron, with which this material communicates its heat to a current of air. I am not aware whether the impracticability of conferring such a temperature as that just named upon the blast, or what the circumstances are, which have led to the abandonment of the hope of obtaining a ton of iron with three-quarters of a ton of coke or less, but 18 cwt. or thereabouts is still confidently predicted as being the future consumption of fuel, in the North of England, by one or two gentlemen.

In confirmation of this doctrine, limited periods of working have been given, showing what I regard as an exceptionally favorable state of things. It is unnecessary, however, in the presence of practical men, to dwell on the unsatisfactory character of the results of a single week, where there are so many disturbing elements familiar to any one with any knowledge of a blast furnace. That which can be done for one week ought to be capable of indefinite repetition, and until this is accomplished, I prefer seeking for an explanation of those causes which appear to me to present a barrier in reducing the weight of fuel required in the blast furnaces of the North of England. From what has preceded, economy in this respect has to be achieved, it is pretended, by extraordinary dimensions of the furnace, and by a substitution of heat conveyed into its hearth by the blast, for that evolved by the coke or other fuel. I propose examining these two branches separately. In order to effect any saving by an addition to the capacity of the furnace, we must dismiss as untenable the idea already propounded of there being any actual evolution of heat in the zone of reduction, because by it there must prevail a constancy of temperature from the reasons already explained in connection with this part of the process, to whatever height the furnace is carried. We shall, therefore, regard the temperature of the escaping gases as one determined, not by chemical action, but by a current of heated vapors, meeting another of solid cool matter, and view the question as one ascertained by actual experience and observation. The cooling power of the solid matter on the gases ought, in such a case as that supposed to be influenced by the time in which the two classes of substances remain in contact with each other. The following sets of figures, exhibiting the quantities of solid and gaseous substances passing through furnaces of four different sizes, will give an idea of the opportunity afforded by each to intercept the heat contained in the gases, and so returning it for useful purposes to the hearth.

	Cwts. of materials descending and cubic meters of gas (0°C. and 760 mm.=32°F. and 30 in. Bar.) ascending per minute.		These quantities compared with each 1,000 cubic feet space per minute.	
Dimensions of furnace. Cubic Feet.	Cwt. of materials.	Cubic meters of gas.	Cwt. of materials.	Cubic meters of gas.
48×16= 6,000	1·863	138	·310	23
80×19=12,000	1·973	132	·164	11
80×20=16,000	2·654	178	·166	11·1
80×25=26,000	3·033	203	·116	7·8

The mean temperature of the gases leaving the furnace of 6,000 cubic feet, may be taken at 450° C. (842° F.), whereas from that of 12,000 cubic feet they were about 120° C. (216° F.) below this. We would be quite prepared for learning that although the furnace standing third in this list is 33 per cent. larger than its immediate predecessor, its gases should, nevertheless, escape at the same temperature, because the ratable work performed is almost precisely the same in each case. When, however, we come to the last one, with a capacity of 26,000 cubic feet, and only doing 70 per cent. of the duty of the previous two, and are informed that no further cooling at the escape pipe is accomplished, we are constrained to admit that furnaces of 12,000 cubic feet have done all that can be effected in the direction in question. I may add that since these calculations were made, other furnaces, having a cubic content of 22,500 feet, have been set to work with precisely the same results, and when it is stated that the observations upon which the estimates are based extend over several years upon no less than eighteen furnaces, it must be allowed ample opportunity has been enjoyed to test their correctness.

It may be observed before leaving this subject that, on the assumption of the gases being cooled by simple heat-abstraction, as has been claimed from 330°C. (626°F.) to about 165°C. (329°F.), the heat thus intercepted is represented by about 1 cwt. of coke, burnt or oxidized, as happens in a blast furnace in the Middlesbrough district. This, therefore, would be the amount of economy capable of being realized by such a change, were it possible. Of course such an extent of cooling as that named is quite conceivable, if the materials charged contained an unusual quantity of water, but my remarks contemplate the existence of no such cause of disturbance. Whether the constancy of temperature in the vaporized substances which leave our furnaces, after certain capacities are obtained, be regulated by reactions of a chemical nature in their upper regions or not, we must look, I would submit, to the science of chemistry if we wish for further enlightenment before introducing changes in a plant involving the outlay of enormous sums of money.

In directing attention to an examination of the natural laws which govern the action of an agent like carbonic oxide or an iron ore, I will be as brief and as free from scientific detail as possible.

In the course of experiments, already referred to, it was proved that the roasted ironstone of the Cleveland hills manifested signs of reduction when exposed to a current of pure carbonic oxide, at a temperature of about 200° C. (392° F.), and it has already been stated in the course of these remarks that deoxidation was rapidly promoted by each succeeding elevation of temperature. We have already seen how the existence of an excessive quantity of carbonic acid, the gaseous product of the reduction of oxide of iron, operates on the fuel in the smelting furnace; but, irrespective of this, the reducing power of carbonic oxide has a limit, that is, it cannot go on indefinitely depriving an ore of iron of all its combined oxygen. As an illustration of this limited power let us imagine a quantity of oxide of iron raised to a full red-heat and in that condition to have a stream of gas in which one half of the volume of carbonic oxide has already been converted into carbonic acid.

Reduction would go on until the peroxide of the ore lost one-third of its oxygen and was brought to the state of protoxide, when further action ceases.

Again, instead of an ore of iron, let a specimen be taken in which the iron had been perfectly reduced to its metallic condition. On treating this precisely as was the oxide, we will find it robs the carbonic acid of the mixed gases of oxygen, and this continues until the iron has become converted into protoxide. Equal volumes, therefore, of carbonic oxide and carbonic acid and protoxide of iron at a full red heat, present an example of static equilibrium, which is incapable of disturbance.

To enable metallic iron to split up or decompose carbonic acid, a higher temperature is necessary than that at which carbonic oxide is enabled to reduce the ore. Two hundred degrees (392° F.) has been cited as that required for the last-named reaction in the case of Cleveland iron-stone, but to enable carbonic acid to reoxidize the reduced metal, a temperature of 400° C. (752° F.), is necessary. We thus perceive that while the heat prevailing in the upper region of a furnace suffices for reduction it is incapable of producing reoxidation.

There are thus in a blast furnace two antagonistic forces at work, carbonic oxide tending to reduce the ore, and the resulting carbonic acid tending to reoxidize the newly-formed metal, or, what is the same thing, preventing its formation. The annexed table shows how these forces hold each other in check at different temperatures, when passed over metallic iron in its spongy form:

	Temperature.	Oxidation of iron.
100 vols. CO, with 100 vols. CO_2	417° C. (782° F.)	nil.
" " " " 150 " "	Low red heat.	Not ascertained. Composition of gases permanent.
" " " " 47 " "	Full red heat.	1/8 of that in peroxide iron.
" " " " 11 " "	Appr'ching whiteness.	1/8 " " "

Notwithstanding what has preceded, it must not be inferred that peroxide of iron is incapable of completely converting carbonic oxide into carbonic acid, but then the iron oxide must be in large excess, in other words, this gas is only capable of removing a very small portion of the oxygen in the ore. As a natural consequence to this state of things we might expect each successive portion of oxygen which is removed from an ore to leave its associated iron with increased slowness. Accordingly I found that the loss of the gas at the lower temperature was in the first double that it was in the ninth hour of the exposure of the ore.

The facts and figures just quoted prove, firstly, that temperature promotes the reducing power of carbonic oxide; secondly, that carbonic acid retards it; thirdly, that the points of neutral action vary with the temperature.

With the information afforded by these three modifications of the action of a mixture of carbonic oxide and carbonic acid on an ore of iron at different degrees of heat, nothing can be more apparent than that we ought to be able to determine experimentally whether the gases as they leave a blast furnace, from their composition and temperature, have had their powers of reduction exhausted. All that is required is to immerse ironstone in the orifice which leads the gases away and see whether it suffers any deoxidation. Accordingly, calcined Cleveland stone was so placed in the gases immediately as they issued from a furnace 48 feet in height and containing 6,000 cubic feet. In these gases 20 volumes of carbonic acid were associated with 100 volumes of carbonic oxide, the average temperature being about 450° C. (842° F.). In twelve hours 55 per cent. of the original oxygen was removed, proving that the deoxidizing agent in this case was escaping long before its powers of reduction were neutralized. When, however, a similar experiment was tried in a furnace of 15,000 cubic feet, 24 hours exposure of the ironstone only removed 4 per cent. of its oxygen. In this case each 100 volumes of carbonic oxide were accompanied by 40 to 45 volumes of carbonic acid, and their mean temperature was about 300° C. (572° F.). There was no notable difference between the action of this furnace and one of 12,500 cubic feet, while one of 26,000 cubic feet failed to do more than had been achieved by that containing 15,000 cubic feet.

From the observations recorded in respect to the stationary temperature of the gases and their inability, on leaving an 80-feet furnace of 15,000 cubic feet, to act chemically on Cleveland ironstone, it seems to me we may conclude that a position of equilibrium has been reached which indicates the inexpediency of attempting to obtain a greater amount of useful effect by a mere increase of size.

From a variety of causes it rarely happens that a blast-furnace works up to what we will assume to be its theoretical maximum of effect. I do not remember that upon any occasion I found the proportions of carbonic acid and

carbonic oxide to exceed 45 volumes of the former to 100 of the latter. There are, however, reasons, which a chemist will understand, why the two states of combination in which carbon is found in the gases may probably be those of a simple relation to each other. Now, something like 48 volumes of carbonic acid to 100 of the lower oxide gives one equivalent of carbon as carbonic acid to two as carbonic oxide.

If this assumption be the correct one we can estimate a minimum of carbon required in smelting such an ore as that employed during my researches. In this calculation a ton of pig iron is regarded as containing 18·6 cwt. of iron and ·60 cwt. of carbon, and supposing this carbon to be derived from dissociated carbonic oxide.

	Cwt
Each ton of metal will give of carbon, in the form of carbonic acid gas...	6·58
To maintain the equilibriumsupposed, in which is the form of carbonic oxide, there must be double the quantity of carbon, we have.....	13·16
To which must be added the carbon dissolved in the pig iron.....	·60
	20·34
Of the carbon found in the gases the limestone used contributed.....	1·32
Leaving the fuel to supply the remainder.....	19·02

To obtain the equivalent of this carbon in coke we must make a proper allowance for impurity, which in the best of the South Durham coal-fields is occasionally as low as 5 per cent., thus bringing about a ton of coke to a ton of pig. I have heard of iron in my own neighborhood being produced with as low a consumption as that just named. This certainly does not accord with my own experience by 2½ to 5 per cent. even with the best materials and every thing in a state of favorable working. Each unit of iron obtained from the ironstone of the Cleveland hills may be regarded as necessitating the expenditure of 4,250 heat units, which with 450 units usually carried away in the gases gives 4,700 as the total requirement. Now, a trifle above 22 cwt. of such coke, as is in common use, does not usually afford above 4,100 heat units, thus leaving a deficiency of 600 units, which is furnished by and is that really contained in the heated blast.

I have at an earlier period endeavored to show that the efficacy of the hot blast did not depend upon any change in the intensity of the heat or nature of combustion in the hearth, but that it operated in a two-fold capacity. It contributed as much heat to the general fund, and it virtually increased the beneficial capacity of the furnace. When, however, the latter is ample in size, affording the gases sufficient time to accomplish their work with a mimimum of loss, then the heat of the blast does its ratable share of the work and no more.

It may not be devoid of interest to consider shortly, what ought to be the consumption of coke in an 80-feet furnace of say 15,000 cubic feet, blown with cold air, adopting as a standard of comparison the performance of a similar furnace, receiving its blast at 485° C. (905° F.) assuming the coke to be oxidized to the same extent, in both cases it is clear we must supply the heat furnished by the hot blast by heat, to be obtained by burning an additional quantity of fuel in the furnace itself. This addition, however, will be burned only to the state of carbonic oxide, the ore having furnished all the oxygen capable of raising this gas to the condition of carbonic acid. Making proper allowance for ash and for the greater amount of heat, which will be carried away in a larger volume of escaping gases, it will be found that about 6 cwt. of coke per ton of iron, would be needed to make up the deficit. Hence, a furnace using 22 cwt. per ton, with a blast heated to 485° C. (905° F.), would consume about 28 cwt. when the air is employed at atmospheric temperature, a rate of consumption which accords with actual experience. This affords an additional proof, if such be necessary, that heat contained in the blast differs in no way from that evolved by the coke.

Before leaving the subject of the oxidation of the furnace gases, it must be remembered that the preceding remarks are applicable only to a furnace kept regularly filled. If this be neglected, a loss of fuel may be the result, notwithstanding that the carbonic acid increases largely in quantity. The effect of this is manifested in a rise of sensible heat in the gases themselves, which accounts at once for the prejudicial effect, well known to furnace managers, on work performed under such circumstances. If then, as experience has demonstrated, no benefit in the matter of coke has been derived from increasing the size of our furnaces in Cleveland, beyond a height of 80 feet, with a capacity say of 15,000 cubic feet, let us consider whether any advantages, in respect to the weight of production, have accompanied the more recent additions of size. This question has been indirectly alluded to when speaking of the relative quantity of solids and gases, passing through furnaces of different dimensions, but for our present purpose, I will quote the actual make of iron from furnaces of the four dimensions already quoted.

Height of furnace, and size of bosh	48x16	80x19	80x20	80x25
Cubic contents, feet	6,000	12,000	16,000	26,000
Average of weekly make, for 1,000 feet of capacity, tons	36.6	23.7	21 8	15.3

These figures show that a furnace of the largest size given, does not perform within 30 per cent. of the ratable work compared with one of 16,000 cubic feet. I would remark that, having abundant blowing power, as well as the means of heating an extraordinary supply of blast to some of the furnaces at the Clarence Works, attempts from time to time have been made to bring up the ratable make of the larger furnaces to that of the smaller of those having in both cases a height of 80 feet. These attempts have always failed, because they were invariably accompanied by a notable increase in the consumption of fuel, arising partly from mechanical difficulties in the management of the furnace, on which want of time here will not permit me to dwell. Let me say, however, in reference to this question of dimensions, that I am not prepared to advise any serious reduction from the largest furnace mentioned in this communication, because there are matters connected with manual labor, which, from a commercial point of view, lead me to prefer furnaces of a capacity beyond that where efficiency in other respects has ceased to advance.

In the event of my having been fortunate enough to make myself perfectly understood in describing the chemical reactions which take place during the smelting of iron, and the manner in which they are affected by temperature, little need be said, if the opinions expressed thereon be correct, on the inutility of raising the heat blast beyond a certain point. This belief is based on the idea that a certain position of carbon oxidation cannot be exceeded, and that as soon as the heat contained suffices to make up the total sum required after the fuel has been oxidized or burnt to the maximum state permitted by the nature of the process, further elevation of temperature in the blast is useless.

To those who have never studied the action of the blast furnace as a question of abstract chemistry, it may appear incredible that a quantity of heat represented by the difference of blowing in air at 480° C. (896° F.) and at 750° C. (1382° F.) should be unproductive of any benefit in an operation where heat undoubtedly plays so important a rôle as it does in the smelting of iron.

This advantage has been publicly stated by one of the advocates for the use of superheated air in furnaces of the largest size to be 2 cwt. of coke for every 111° C. (200° F.) added to the temperature of the blast. It has been demonstrated, it is hoped with sufficient clearness, on physical grounds, firstly, that no such rule as that laid down is possible; and secondly, that when the furnace is sufficiently capacious the coke saved is equivalent, and no more than equivalent, to that contained in the blast. Now the difference between 480° C. and 750° represents 456° F., which, at 2 cwt. of coke, the economy claimed, represents fully 4½ cwt. of this description of fuel, whereas the actual difference of heat in air at the one temperature and the other barely amounts to 1¼ cwt. of coke, which is a proof of the unsoundness of the statement of the saving.

Looking at the complicated nature of the changes which accompany the smelting of iron, and at the difficulty of examining with the necessary precision each step in the process, it is not surprising that some doubt should, on the question before us, still linger in the minds of some who have upheld the value of superheating the air consumed in the blast furnace. With such conflict of opinion there is no alternative but to examine with the requisite care the results of actual experience. A large quantity, as much as 2,000,000 tons, I understand, of pig is annually made with superheated air, and certainly, so far as its application to the furnaces of the North of England is concerned, there has been obtained as favorable results in furnaces of 22,500 cubic ft, with blast at about 485° C. (900° F.), as have been commanded by other manufacturers in furnaces one half larger, and blown with air fully 200° C. (360° F.) higher than that in use in smaller furnaces.

Reference in an earlier part of this paper was made to the greater facility with which the red hematite of Lancashire suffered reduction, when compared with the ore of Cleveland, the difference being stated as 7 to 5. This hematite was treated in furnaces 55 feet high, in which a ton of pig iron was smelted with an equal weight of coke or thereabouts. When the ironmasters of the West of England learnt that an advantage had followed the use of large furnaces and of superheated air on the East coast, one of their number was soon found following so encouraging an example. This costly change in the Lancashire plant has been unproductive of any benefit, for the simple reason that with an ore so susceptible of reduction as that in use in that district, the position of static equilibrium, already explained, is secured in furnaces of smaller capacity than happens when the mines furnishing the more refractory ore of Cleveland are the source of supply. It is, however, needless to quote the experience of English ironmasters to an assemblage containing within its ranks names of great eminence in the American iron trade. In no country are there more striking instances of the different character of ores than in the United States, and every one who has studied the question is fully aware that large quantities of iron are run from individual furnaces of very moderate size. These are blown with air of no extraordinary temperature; the consumption of fuel at the same time does not exceed that in the lofty furnaces of the North of England.

This is so peculiarly the case when the iron is produced by means of charcoal, that I avail myself of the present opportunity to recommend the action of these furnaces as a subject of special study to those who have the time and opportunity to devote to this interesting subject. There are actually to be found instances in different American localities where furnaces 40–42 feet high, with boshes of 9½ feet, and therefore containing probably not above 1,500 cubic feet, are running 250 tons of the richest gray iron in a week. This extraordinary production for such a capacity is achieved with the blast at 370° C. (700° F.), no benefit accruing from raising it to a higher temperature, and yet in some cases a ton of metal is said to be obtained for even less than an equal weight of charcoal.

The opinions just set forth on the inexpediency of heating air beyond a certain point are only applicable to furnaces where the dimensions are sufficiently large to afford the reducing gas ample time to expend its energy on the work it has to perform. Precisely in the same way as a small cold blast furnace of 6,000 cubic feet has its activity promoted by heating its air to 600° F., so a larger one, say of 8,000 cubic feet, may have its blast advantageously raised from 900° to 1,200° F. What I maintain is that dimensions of furnace and temperature of blast are convertible terms until we arrive at a certain composition of the gases. This composition infers so much carbon (one-third, I have assumed) burnt as carbonic acid, and two-thirds as carbonic oxide, and carbon thus burnt means a given quantity of heat. The heat required for smelting iron varying in amount with different kinds of ores, the extent to which that afforded by the combustion of the fuel has to be supplemented by the heat contained in the blast also varies. In illustration of this law furnaces of 10,000 cubic feet in England are found doing the same work, in point of consumption of coke, as others at 15,000 feet, but in the former case the blast requires to be elevated to 700° C. (1,290° F.), whereas 480° C. (896° F.) suffices in the latter. This experience of the Old World seems to be confirmed by that of the New, for we are informed very recently, through the columns of your own journal, that the furnace at Port Henry has been running 300 tons a week, burning a trifle under 23 cwt. of anthracite coal with air at 1,350° to 1,400° F. Almost precisely the same results are being obtained at Glendon, with its blast heated in iron stoves to a very moderate temperature, the fuel being also anthracite, and the ore treated, I believe, not less refractory than the rich produce of the Lake Champlain Mine. The furnace at Glendon, however, contains close on 12,000 cubic feet, and is almost exactly one-half larger than that at Port Henry.

A word or two of explanation before I conclude as to what is supposed to become of the additional heat received from superheated air by a furnace sufficiently large not to require its aid. We have already seen what happens when the dimensions are below that required for the economical treatment of an ore. In it the oxide of iron reaches a zone of the furnace where the high temperature enables the carbonic acid produced by reduction to dissolve carbon, without the evolution of heat. Let us imagine the case of a furnace sufficiently large to have reached the limit which on theoretical grounds I have assumed as the true one. In it let us further suppose that the blast is exactly raised to the temperature which enables it to supply the heat in deficit after the fuel has been oxidized to the extent described. If in such a case a large amount of heat is conferred upon the blast, as can be done with the fire-brick stove, the zone of high temperature commences *pro tanto* to extend itself toward the throat of the furnace, where it meets with unreduced oxide of iron. Such a mode of procedure is clearly equivalent to letting the ironstone descend to the region of high temperature before it is perfectly reduced, in both cases heat is wasted by the unburning, as I have termed it, of carbonic acid.

In closing these remarks on the theory of the hot blast and on its action, I

may state that the views I have endeavored to explain to my brother ironmasters on this side of the Atlantic are founded on experimental labors and investigations having for their object the solution of a purely practical question. My firm was among the first who proposed following up the idea of my late friend, JOHN VAUGHAN, which we did by the adoption of dimensions nearly one-third larger than those he had attempted, to which was applied blast at a temperature beyond that he could at that time command. The results indicated some improvements by this change of conditions, and it therefore became absolutely necessary for our own guidance in the future to learn whether any further addition to the capacity of the furnace or to the temperature of the blast would present any advantage in the economy of fuel.

When, with the Cleveland ironstone, the furnace has reached, at the very outside, 15,000 cubic feet, and has its blast heated to 485° C. (905° F.), I answer this in the negative. If the opinions thus formed embrace any fallacy, they at least possess the recommendation of constituting those upon which I have recommended those associated with me to act. As such it affords me much pleasure in submitting them to the criticisms of my associates in the Institute of Mining Engineers of this great country; an Institution which has distinguished me by adding my name to its small list of honorary members, and from which I received so many proofs of most friendly welcome upon the occasion of my former visit.

PHILADELPHIA, June 28, 1876.

COLORADO MINING NOTES.—(Georgetown *Miner*, June 24th.)—*The Atlantic Lode*, on Brown Mountain, Clear Creek County, still maintains its reputation as a regular producer of high grade ore. The lessees are at present working a force of nineteen men, and are pushing things vigorously. The breast of the lowest drift is now in to a point about 300 feet below the surface. The pay-streak is from 1 to 4 inches wide, and very regular; with the exception of a few feet, the last 130 feet of the level has shown an unbroken streak of very rich ore, and at the present time shows indications of approaching one of the rich "pockets" frequently struck here. The mine is kept in excellent shape, and well timbered.

The Cascade Lode, lying a few miles east of Georgetown, can be traced from Ute Gulch, at the point where the tunnel has been started on it, across the mountain to Cascade Creek, a distance of a little more than a mile. It is a monster lode, if we may judge from the prominence and immense width of the quartz outcroppings. Several shafts have been sunk on it, in different places, and wherever opened, pay ore has been taken out. The tunnel is substantially timbered as far as necessary, and is supplied with a railway track the entire distance it has been driven—325 feet. In the present breast of the tunnel there is about five inches of good ore, on the hanging wall. The certificates of thirty-one tons of ore taken out in driving the tunnel, and sold at the Whale mill, ranged from 106 ounces to 530 ounces silver per ton, giving a general average of about 250 ounces. Specimen assays have run as high as 1,864 ounces. The quartz is an iron-stained, hard, yellow, compact rock, and any of it will assay from 20 to 53 ounces; one lot of four tons of this rock showing no mineral, and reduced as an experiment, yielded 53 ounces of silver per ton. The mineral streak carries galena, black sulphurets, gray copper, ruby, wire and leaf silver.

STATISTICS OF COAL PRODUCTION.

This is the only Report published that gives full and accurate returns of the production of our Anthracite mines.

Comparative Statement for the week ending June 24.

Tons of 2,240 lb.	1876. Week.	1876. Year.*	1875. Week.	1875. Year.*
Wyoming Region.				
D. and H. Canal Co	—	868,105	68,051	1,532,542
D. L. and W. RR. Co.	20,102	589,051	75,276	1,440,728
Penn. Coal Co	855	404,654	33,516	605,924
L. V. RR. Co.	10,190	412,562	12,199	382,655
P. and N. Y. RR. Co.	293	12,406	2,410	52,816
C. RR. of N. J.	1,382	550,390	24,852	241,797
Penn. Canal	9,704	122,538	2,815	6,385
	42,526	2,959,706	219,119	4,262,847
Lehigh Region.				
L. V. RR. Co	29,792	991,639	13,801	201,398
C. RR. of N. J.	1,069	501,957	318	7,720
D. H. and W. B. RR.	—	16,304	3,110	30,436
	30,861	1,509,900	17,229	239,554
Schuylkill Region.				
P. and R. R. RR. Co.	4,613	1,747,402	117,770	713,445
Shamokin & Lykens Val.	17,788	360,482	31,942	515,415
	22,401	2,107,884	149,712	1,228,860
Sullivan Region.				
Sul. and Erie RR. Co.	121	26,314	—	5,557
Total	95,909	6,603,804	386,060	5,736,818
Increase	—	866,986	—	—
Decrease	290,151	—	—	—

* Year beginning January 1st.

The above table does not include the amount of coal consumed and sold at the mines, which is about seven per cent. of the whole production.

Perth Amboy business:

	Tons.
Received for the week	10,810
Shipped for the week	18,807
On hand June 24	81,361

Freights to New York, 35c.; Boston, 95c; Hartford, 90c.

Receipts of Coal at Boston, for week ending June 23, and years from September 1st, 1874 and 1875.

From	Week. Tons.	Previously. 1876. Tons.	1875. Tons.
Alexandria and Georgetown	1 472	68,140	70,282
Philadelphia	13,003	515,235	331,717
Baltimore	4,191	108,535	136,466
Other places	4,414	238,724	194,240
Great Britain	—	4,510	2,224
Nova Scotia	1,732	15,545	18,713

Belvidere Delaware RR. report.

	Week.	Year 1876.	Year 1875.
Receipts of coal at Coal Port (Trenton)	4,089	91,615	206
" " " South Amboy	4,760	198,336	20,444
Shipments at Coal Port (Trenton)	6,373	90,500	196
" South Amboy	10,304	192,744	98,504

The Production of Bituminous Coal for the week ending June 24, was as follows:

Tons of 2,000 lb., except where otherwise designated.

Cumberland Region, Md.	Week, Tons.	Year, Tons.
Tons of 2,240 lb	42,901	741,891
Barclay Region, Pa.		
Barclay RR., tons of 2240 lb	5.166	154,708
Broad Top Region, Pa.		
Huntingdon and Broad Top RR	2,011	75,355
*East Broad Top	1,362	33 552
Clearfield Region, Pa.		
*Snow Shoe	1,123	27.690
*Tyrone and Clearfield	22,283	519 778
Allegheny Region, Pa.		
*Pennsylvania RR	4,529	95,165
Pittsburgh Region, Pa.		
*West Penn. RR	2,940	95,152
*Southwest Penn. RR	1,438	27,404
*Penn. & Westmoreland gas coal, Pa. RR.	18,429	350,996
*Pennsylvania RR	6,991	142,545

* For the week ending June 14.

The Production of Coke for the week ending June 14.

Tons of 2000l b.	Week. Tons.	Year. Tons.
Tyrone and Clearfield	..	..
Alleghany Region	..	..
West Penn. RR	998	21.803
Southwest Penn. RR	9.792	223,566
Penn. & Westmoreland Region, Penn. RR.	982	20,146
Pittsburgh, Penn. RR	3,583	90,781
Total	15,355	356,296

The decrease of shipments of Cumberland Coal over the Cumberland Branch, and Cumberland and Piedmont Railroads amounts to 277,561 tons, as compared with the corresponding period in 1875.

COAL TRADE REVIEW.

NEW YORK, FRIDAY EVENING, June 30, 1876

Anthracite.

THE condition of trade shows no change and there are no signs as to when an improvement will set in. Some of the dealers think that not later than Sept. 1st there must be quite a revival. Basing their calculations upon the business of former years it would be but natural to expect a large business at that time, especially as, from present indications, there will then have been fully 1,000,000 tons less coal marketed than there was at the corresponding time last year. This, however, brings us to the consideration of other questions that have a bearing. The winter of 1874-75 was a very severe one and the stocks of domestic coal were very much reduced, and manufacturing industries although very much depressed were much larger consumers of coal than at present. The winter of 1875-6 was very mild, and towns and cities that were quite bare of stocks in the spring of last year, reported heavy stocks this year. Hitherto many manufacturing companies constantly carried very liberal stocks of coal, that their business might not be interrupted by strikes at the mines, or from other causes. A general feeling now prevails that the price of coal must follow in the decline that has taken place in nearly every other commodity. As there is not the slightest prospect of a strike at the mines, close competition and a sinking market, make it inexpedient for manufacturers to carry large stocks, as was formerly the custom; indeed this has resulted in a general clearing up of stocks and a curtailment of purchases to the early requirements of purchasers.

The great decrease in the consumption of coal has come almost entirely from the manufacturing industries, which, owing partly to diminished wants and partly to stricter economy in its use, are demanding less and less coal each day, and while there are still some buyers who must lay in stocks before the close of navigation, their number is much less than formerly, owing to the increased railroad facilities of the last few years. We do not, therefore, look for the periodical spurts which, in years gone by, characterized the trade, but the business will hereafter be more evenly distributed throughout the year, and this fact will exert a very important influence upon the economy of mining. We shall revert to this important question on an early occasion. Circular prices continue to be undersold as much as at any time this year, and with buyers purchasing at about their own terms, the effect of the circulars announcing advances to take place in August is quite inappreciable.

Bituminous.

There is hardly anything worthy of remark in this branch of the coal trade. The output of the Clearfield Region is not so large as earlier in the season, yet from our latest reports (June 14) we notice that the shipments for the week were still somewhat greater than during the corresponding week of 1875. The total increase from January 1 was nearly 167,000 tons greater than for the same period of 1875. The Cumberland trade shows a falling off of 19,509 tons for last week as compared with the corresponding week of 1875, and a total loss from January 1, as compared with the same period of 1875, of 277,370 tons. Should the same rate of loss continue throughout the year it would make a total for this year of over 600,000 tons, say 25 per cent. of the output of 1875.

**** Wholesale Prices of Anthracite Coal for July, f.o.b. at the Tide Water Shipping Ports per ton of 2240 lb.***

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
Wyoming Coals.						
‡Lackawanna and Scranton at Hoboken and Weehawken	4 75	4 85	4 95	5 05	5 65	4 95
Pittston at Newburg	4 60	4 70	4 80	4 90	5 50	4 80
Wilkesbarre at Port Johnston	4 75	4 85	4 95	5 05	5 65	4 85
Plymouth, R. A.	....	....	4 95	5 15	5 75	4 95
Susque. Coal Co. at Amboy W.A.	4 75	4 85	4 95	5 15	5 65	4 95
Kingston at Hoboken	4 75	4 85	4 95	5 15	5 65	4 95
Lehigh Coals.						
Old Company at Port Johnston	5 25	....	5 05	5 05	5 65	4 95
Old Company's Room Run "	5 25	....	5 05	5 05	5 65	4 95
Sugar Loaf, Hobok. & Amb. "	5 25	....	5 05	5 05	5 65	4 95
Lehigh Coal Exchange "	5 25	....	5 05	5 05	5 65	4 95
Honey Brook Lehigh	5 25	....	5 05	5 05	5 65	4 95
Beaver Meadow at South Amboy	5 25	....	5 05	5 05	5 65	4 95
Schuylkill Coals at North 9th st., Brooklyn, E. D.†						
Schuylkill white ash	4 75	4 85	4 95	5 05	5 65	4 85
Schuylkill red ash	....	....	....	5 15	5 75	4 85
Shamokin white and red ash	....	....	....	5 25	5 75	4 85
Lorberry	....	....	5 85	5 85	5 85	4 90
Lykens Valley	....	....	6 30	6 30	6 30	5 35

* Contractor's prices are 20c. per ton less.

†The prices of Schuylkill coals for shipment from Philadelphia are 35c. per ton less than at Brooklyn.

‡ Boats towed by the D. & H. C. Co. at its expense to and from New York harbor.

	Per ton.
Freight from Hoboken and Weehawken to New York	40c.
" " Elizabethport & Port Johnston to N. York.	40c.
" " South Amboy to New York	30@35c.

Freight by the boats of the companies from Hoboken, Port Johnston, Weehawken, Rondout, South Amboy and Perth Amboy to New York City and vicinity 50c

Freight by the Pennsylvania Coal Company's boats from Newburg to New York 65c.

Wholesale Prices of Bituminous Coal.

Per ton of 2240 lb.	At the Shipping Ports.	Alongside in New York.
Domestic Gas Coals.		
Westmoreland and Penn. at Greenwich, Philadelphia	$4 70	$6 00
" " at S. Amboy	5 50	6 00
Red Bank Cannel Pa. at Philadelphia	8 00	8 50
" " South Amboy	8 50	....
" Orrel	6 00	6 50
Youghiogheny, Waverly Co., at Balt	4 25	5 75
Despard, West Va.	4 50	6 00
Murphy Run, West Va., at Baltimore	4 50	6 00
Fairmount, West Va., " "	4 50	6 00
Newburgh Orrel, Md. " "	4 35	6 00
Cannelton Cannel, W. Va.	4 50	6 00
" Splint, " at Richmond.	....	10 00
" Gas Coal at Richmond	4 50	6 00
Peytona Cannel, W. Va. at Richmond	4 00	5 50
Manufacturing and Steam Coals.	8 50	10 00
Cumberland, at Georgetown and Alexandria, Va.	3 50@3 75	5 00
Cumberland, at Baltimore	3 80@4 00	5 25
Clearfield f.o.b. Canton, Baltimore	3 90@....	5 25

Rockhill Semi-Bituminous and Broad Top, at the mine, per 2,000 lb., 90, f. o. b. Greenwich, Philadelphia, per 2240 lb., $3 60@3 95, according to destination; at Amboy, 4 60; New York, 5 00.

Clearfield and Allegheny, "Kittanning," "Sterling," "Sonman," and "Eureka," at the mines, per 2000 lb., 90; at Greenwich, Phil., per 2240 lb., 3 75@4 25, according to destination; f.o.b. South Amboy, N. J., 4 75; New York, 5 25.

Foreign Gas Coals.	Sterling.	Am. cur'cy,
Newcastle, at Newcastle-on-Tyne	9/6@11/	6 50@ 7 00
Liverpool House Orrel, at Liverpool	26/	13 00
Ince Hall Cannel "	42/	18 00
" Gas Cannel "	28/	13@14
Scotch Gas Cannel, at Glasgow, nominal,	25/	7 50
	Gold.	
Block House, at Cow Bay, N. S	2 00	4 75
Caledonia, at Port Caledonia	1 50	4 25
Glace Bay, at Glace Bay	1 50	4 25
Lingan, at Lingan Bay	1 75	....
Sydney, International and Reserve mines, at Sydney	2 00	5 50
Pictou, Albion & Vale mines, at Pictou.	2 25	5 75

Retail Prices in New York.

Anthracite.

Per 2000 lb.	Grate and Egg.	Stove.	Chestnut.
Pittston coal, in yard	$5 70	$6 00	$5 30
Lackawanna coal, in yard	5 70	6 00	5 30
Wilkes-Barre, delivered	6 25	6 75	6 00
Lehigh & Locust Mountain, del'd	7 00	7 00	6 00
Schuylkill Red Ash, del'd	7 50	7 50	6 00

The Cost of delivery for Pittston and Lackawanna coal ranges from 40 cts. to $1 10 per ton, according to distance from the yard.

Bituminous.

Liverpool House Orrel, delivered, per ton of 2000 lb				$18 00
Liverpool House Cannel	"	"	"	22 00
American	"	"	"	13 00
Cannelton splint,	"	"	"	8 00
Cannelton Block,	"	"	"	8 00
American Orrel	"	"	"	11@14
Red Bank Cannel	"	"	"	14 00
Cumberland	"	"	"	7 00

Baltimore, Md. June 30, 1876.

Reported by our Special Correspondent.

ANTHRACITE.

Wholesale or Trade Prices per 2240 lb.

Wilkes-Barre "Lee" or "Diamond," Pittston and Plymouth, White ash.	In cars at depot.	By boats afloat.
Lump and steamboat	$4 62	$4 47
Broken	5 10	4 85
Egg	5 20	4 95
Stove	5 51	5 36
Nut	4 66	4 51
Shamokin (red or white ash), and "Boston," free burning white ash,		
Egg	5 20	5 00
Stove	5 50	5 25
Lykens Valley, red ash,		
Egg and stove	6 05	5 68

From wharf or yard, wholesale, 50@75c. additional.

By retail, all kinds and sizes, per 2240 lb. $5 25@7 75

BITUMINOUS.

George's Creek, Cumberland f. o. b. at Locust Point. 3 90@4 00

West Virginia Gas f. o. b. at Locust Point 4 50

Youghiogheny Gas, f. o. b. at Locust Point 4 50

Boston. June 26, 1876.

COAL is without the slightest confidence. The circular announcements of the regular July advance in anthracite, supplemented by the advice that 15c. additional will be added the following month, suggests that a further 15c. may be added, and so in the end there will be stronger inducements for manipulations outside of the Combination, and with these extortionate advances it seems likely that outside coals will be placed regularly through the Autumn. Some of our largest dealers had a New York visitor this week willing to contract to deliver egg sizes any time within the next four months at the lower or consumers' April-circular rates, and would guarantee to deliver stove sizes 25c. under the present New York delivery prices any time in August. It is thought that he took away orders from our local trade for about 18 cargoes.

BITUMINOUS is a trifle irregular also, and one or two of our large manufacturing concerns to the North have been offered cargoes, but not to unload at Boston, 50c under the current rates. Evidently there's something as interesting in soft as in hard coals.

Freights are easy, quoting New York 90c; Philadelphia $1 15@1 25; Baltimore $1 44@1 50; and Georgetown $1 50@1 60.—*Commercial Bulletin.*

Buffalo, N. Y. June 29, 1876.

Reported by our Special Correspondent.

Deliv'red at	Elmira	Ithaca.	Syracuse	Rochester.		Oswego
	Afloat.	Afloat.	Afloat.	afloat	ret. del.	f.o.b.
Grate	$4 05	$4 35	$4 50	$5 20	$6 45	$5 45
Egg	4 05	4 35	4 50	5 20	6 45	5 45
Stove	4 45	4 80	4 95	5 65	6 90	5 90
Nut	4 15	4 50	4 65	5 35	6 60	5 60

Delivered at	Erie.	Buffalo.		
	f.o.b.	Afloat.	f.o.b.	ret. del.
Grate	$5 95	$5 45	$5 95	$6 70
Egg	5 95	5 45	5 95	6 70
Stove	6 40	5 90	6 40	7 15
Nut	6 10	5 60	6 10	6 80

Cincinnati, O. June 27, 1876.

Reported by our Special Correspondents.

Market nominal and dull, with prices same as last quoted.

Per ton of 2000 lb.	Bush.	Ton.
Youghiogheny, or Pittsburgh, afloat	7½@8c.	—
Pomeroy coal	5 @6c.	—
Kanawha " "	7 c.	—
Cannel coal, according to quality "	11 @16c.	—
The following are the retail prices delivered		
Youghiogheny	10c.	—
Pomeroy	9c.	—
Cannel	14@22c.	—
Kanawha Semi-Cannel	10c.	—
Anthracite, per ton	10 50@11 00	—
Coke, at yard	7c.	—
Coke, hard and soft, delivered	9@10c.	—

Cleveland, O. June 28, 1876.

Specially reported by Messrs. BATES & MARTIN.

Herewith find quotations of our market:

Per ton of 2000 lb. f. o. b. vessels.

WHOLESALE.

	For vessels,	On cars.
Youghiogheny Gas Coal	$4 10	$4 00
Cannel	4 25	4 15
Blossburgh	$5 00	$5 00
Briar Hill, Block Coal	3 50	3 25
Straitsville Coal Co., lower vein	3 00	2 90
" " " whole "	2 90	2 80
Hocking Valley	2 90	2 90
Massillon	3 00	3 00
Tuscarawas Valley	2 65	2 60
Columbiana	2 65	2 60

Office of CLEVELAND COAL EXCHANGE,
89 Seneca Street, June 3d, 1876.

PRICES TILL FURTHER NOTICE.

	1 to 10 tons.	10 tons upw'd.
Massillon, Brier Hill and Mineral Ridge, lump	$4 50	$4 25
" " " " nut	4 00	3 75
Straitsville Lower Vein, Hocking & Shawnee, l'p	4 00	3 75
" " " " nut	3 50	3 25
Del Carbo and Rich Hill, lump	3 75	3 50
" " " " nut	3 25	3 00
Maple Hill, lump	3 50	3 25
" nut	3 25	3 00
Columbiana, lump	3 25	3 00
" nut	2 75	2 50
Lackawanna and Wilkesbarre, egg and grate	7 50	7 30
" " stove	8 00	7 75
" " chestnut	7 75	7 50

No Anthracite coal to be sold for future delivery except it be subject to Exchange price at time of delivery.

H. E. CHUBB, Secretary.

Erie, Pa. June 27, 1876.

Wholesale, per ton of 2000 lb. Bituminous f. o. b.

Briar Hill lump	$3 75	Beaver lump	$3 50
Midway	3 25	Cat Fish	3 00

Indianapolis, Ind. June 27, 1876.

Specially reported by Messrs. COBB & BRANHAM.

Wholesale on board cars, and retail delivered to consumers.

Per ton of 2000 lb., bushel of 70 lb.

BITUMINOUS.

White River, per ton	$2 50	Peytona cannel, per ton.	5 75
Brazil Block, "	2 50	Indiana Cannel	4 50
Highland, grate, "	2 25	Hocking Valley	4 25
Block coal, nut, per car	18 00	Youghiogheny	4 50
Highland " "	18 00	Blossburg (smithing)	6 50
Block Slack " "	17 00	Piedmont "	6 50
		Gas coke, per bushel	10

ANTHRACITE (Lackawanna and Wilkes-Barre.)

Broken	$8 35	Nut	8 50
Egg	8 35	Stove	8 75

Lehigh Anthracite.

Broken	9 75	Nut	9 50
Egg	9 75	Stove	10 00

Retail, per bushel, delivered.

Sand Creek	15c.	Block Nut, steam	8
White River	13	" Slack, "	7
Brazil Block	14	Peytona Cannel	28
Highland grate	13	Virginia "	27
Block Nut, domestic use	12	Youghiogheny	20
Highland Nut, " "	12	Blossburg	26
" " steam	8	Piedmont	26

GAS COKE (measured.)

Crushed	15c.	Lump	12c.

ANTHRACITE,

Wilkes-Barre and Lackawanna (all sizes)	$9 75 per ton,
Lehigh, retail	$11 50 per ton.

Louisville, Ky. June 27, 1876.

Specially reported by Messrs. BYRNE & SPEED.

Our market is now, as during most of the Winter, very quiet.

Please report our prices as follows:

WHOLESALE.

	per bushel		per bushel
Pittsburgh	12c.	Pine Hill	—
Raymond City	9c.	Kentucky	8c.

RETAIL.

	per bushel		per bushel
Pittsburgh	12c.	Peytona Cannel	20@22c.
Raymond City	11c.	Buckeye "	20c.
Pine Hill	13c.	City-made Coke	10c.
Kentucky	10c.	Anth., per ton, $10 00 to 10 50	

Screened ittsburgh per load	$3 00
Screened Raymond City	2 75
Pine Hill (Kentucky)	75
Cannel	$5 to 50

Milwaukee, Wis. June 28, 1876.

Specially reported by Messrs. R. P. ELMORE & Co.

Retail price per ton of 2000 lb.

Lehigh Lump	$10 00	Briar Hill, select	$8 00
Lehigh Prepared	11 00	Blossburgh	8 00
Lackawanna (all sizes)	10 00	Cannel	8 00
Pittston	10 00	Pittsburgh	7 00
Scranton	10 00	Steam coal	7 00

New Orleans, La. June 27, 1876.

Reported by C. A. MILTEBERGER & Co.

Pittsburgh coal, retail, per bbl	50c.
" wholesale	30c.
" steamboats, per box	40c.
" to manufacturers, per bbl	45c.
" shipments, per hhd	$5 50
Anthracite, wholesale, per ton	
" retail, "	12 00
Virginia Cannel, per bbl	80c.
Scotch " "	80c.
Mt. Carbon, wholesale, per bbl	
" retail, "	50c.
St. Bernard wholesale, per bbl	30c.
" retail, "	50c.

Richmond, Va. June 27, 1876.

Specially reported by S. H. HAWES, Dealer in Coal.

Per ton of 2240 lb., f.o.b.

Kanawha Cannel	$9 00	New River Bituminous,	$4 25
" semi-Cannel	4 75	Clover Hill Coal	4 00
Coalburgh Splint	4 20	James River Bitum	3 30
Lewiston "	4 20	" " Carbonite,	5 80
Kanawha Gas coal	4 15		

San Francisco, Cal.

From the *Commercial Herald*, June 22, 1876.

Imports from Jan. 1st to June 16th:

	tons.		tons.
Anthracite	7,622	Vancouver Island	44,045
Australian	31,089	Rocky Mountain	123
Coos Bay	18,933	Seattle	46,484
Cumberland	3,599	Bellingham Bay	10,820
English	10,831	Chili	1,050
Mt. Diablo	43,969		

Arrivals during the period under review have been very liberal, and by reason of very heavy prospective supplies en route buyers are very reticent about making purchases. Last week we reported an auction sale of a cargo of Westminster Brymebo, ex ship, at $9 which was a full outside price. Since then we are in receipt of the following cargoes; Per *Merchant* from Sydney, 478 tons coal 1,039 tons Shale; per *Frith of Forth* 1,265 tons Sydney Coal: from Seattle, per *J. B. Bell*, 1,225 tons: from Bellingham Bay, 500 tons, per *Amethyst*; from Departure Bay (B. C.) 2,015 ton Wellington; per *City of Lahore*, 1,300 tons Sydney: per *Inglewood*., 1,506 tons Wallsend from New South Wales. It was announced a year ago that the Pacific Mail Steamship Company had made a five years' contract for the product of the Wellington Mine. This report seems to have been erroneous, as the present agents of the P. M. S. S. Co. refuse to recognize the same, and are buying supplies in the open market wherever it can be bought the cheapest. This creates competition among the dealers and will result in low prices. We are already advised of contract sales of Scotch Steam to arrive in the Autumn at $7@7.50 per ton, vessels bound to the Pacific Slope for wheat charters bringing the coal for ballast. We note increased supplies of Shale here and en route for the Gas Company. This article may be quoted at double the price of Sydney coal, though late receipts were sold, we believe, prior to arrival at $23. The price of Mt. Diablo Steam coals has been reduced 50c. per ton. for both coarse and fine, as has also been the case on many if not all other kinds, so much so that at this writing it is really difficult matter to know the true state of the market, everything being done *sub rosa*. We submit, however, the following figures as approximating the market; Wallsend, $9@9.50; Sydney Steam $9; Anthracite, $12@14, latter for Lehigh; Mt. Diablo, $5.75 @7.75 for fine and coarse respectively; Coos Bay, $9; Vancouver, $8@9; Cumberland, $15@18.

Montreal. June 29, 1876.

Specially reported by Messrs. ROBERT C. ADAMS & Co.

Wholesale per ton of 2240 lb.

Scotch Steam	$4 60	Cape Breton Steam	$4 00
Pictou "	4 50	Newcastle Smiths,	5 50

Anthracite at retail, per 2000 lb., delivered.

Egg	$6 70	Chestnut	6 40
Stove	7 15		

Toronto, Ont. June 29, 1876.

Chestnut	$7 25
Stove	7 50
Egg and grate	7 25
Bituminous coal for domestic use	6 00
" " steam	3 50@5 50
Lehigh Lump and broken	7 50
Blossburgh	6 50

Freights.

Per ton of 2240 lb.

PORTS.	From Philadelphia.	From Baltimore.	From Georgetown.	From Elizabethport, Fort Johnson, South Amboy, Hoboken and Weehawken.
Augusta, Me	....	1 90	....	....
Albany	†80	...	...	....
Amesbury, Mass	....	....	....	....
Bangor, Me	....	1 45	....	90
Bath, Me	1 45	1 45	150–55	90
Baltimore	....	....	...	....
Boston, Mass	1 15@1 30	1 45@1 50	1 60	1 00
Bridgeport, Ct	†1 00	1 40	....	60
Bristol, R. I.	....	....	....	80
Cambridgeport, Mass.	§1 25@1 35	....	...	90
Derby	....	....	....	....
Dighton	....	....	....	....
East Cambridge	§1 25@1 35	....	....	§90
Fall River	1 20@1 25	1 40	1 50	80
Hackensack	*70	....	....	....
Hallowell, Me	....	....	....	....
Hartford	*70	....	....	....
Hoboken	†70	1 25	1 35	40
Hudson	....	....	1 50	....
Jersey City	70	1 25	1 35	40
Lynn, Mass	....	....	....	†1 00
Middletown	....	....	....	1 00
Mystic	....	....	....	....
Newark	....	....	1 50	....
New Bedford	1 25	1 40	1 50	00
Newburyport	....	1 00	1 75	1 00
New Haven	*70	1 40	1 45	60
New London	1 20	1 40	1 45	05
Newport	1 25	....	....	80
New York	1 00†	1 30	1 35	40
Norwalk	1 00@1 25	1 50	....	60
Norwich	1 20‡	....	....	70
Pawtucket	1 25‡	....	....	....
Philadelphia	....	....	....	....
Portland	1 25	1 45	....	90
Portsmouth, N. H.	1 30@1 40	1 60	1 65	1 00
Providence	1 20@1 25	1 40	1 45	80
Poughkeepsie, N. Y.	....	....	....	....
Rockport	....	....	....	....
Saco	....	....	175–80	....
Sag Harbor	....	....	....	1 00
Salem, Mass	1 25@1 35	1 45	1 60	90
Salisbury Pt., Mass.	....	....	....	....
Stamford	*70	....	....	60
Stonington	....	....	....	80
Taunton	.. .	..	....	....
Troy	†80	....	....	.. .
Warren, R. I.	....	....	....	80
Wareham	....	....	....	....
Weymouth	....	....	....	....

* And discharging and towing. † And discharging. ‡ And towing. § 30c. per bridge extra.

Rates of Transportation on Anthracite Coal to Tide Ports.

Lehigh and Wyoming Coals. per ton of 2240 lb	From Penn Haven.	From Mauch Chunk.	From Hazleton**	From Upper Lehigh.	From Ashley and Sugar Notch.
To ‡ Newark, N. J. (117 miles), via Central Railroad of New Jersey ..	2 34	2 20	2 76	2 67	2 90
‡ Mauch Chunk, Pa., via Central Railroad of N. J.	14	..	56	47	70
‡ Philipsburg, N. J., (46 miles)	88	74	1 30	1 21	1 44
Elizabethp't, (114 m.) Pt. Johns., Hoboken & South Amboy, N. J., shipping and wharfage 35c. add.	1 98	1 84	2 40	2 31	2 54
High Bridge, N. J.	2 40	1 95	2 80	2 54	2 72
Elizabeth, Cranford, Westfield & Elizabethport, for consumption,	2 34	2 20	2 67	2 67	2 90
Jersey City, N. J., (121 miles) and New York, via L. V. RR.	2 32	2 18	2 65	2 65	2 88
Andover, via Delaware, Lackawanna and Western RR	3 30	3 10	3 70	3 69	3 99
§ Trenton Somerset Junction and Greensburg, via P. RR. Belvidere Division	2 65	2 45	3 05	3 04	3 34
Trenton, (97 m.) for shipment, including shipping and wharfage	2 11	1 95	2 45	2 46	2 76

From *Mauch Chunk* to *New York* (121 miles), (towing limits) and Jersey City† via Lehigh Valley RR. $2 14

From *Mauch Chunk* to *Philadelphia* (93 m.) via L. V. and L. and S. RR. and North Penn. RR 1 75

††From *Phillipsburg, N. J.* to *Hoboken* (84 m.) for shipment via Delaware. Lackawanna and Western RR., Morris and Essex Division 1 10

From *Lackawanna Junction* to **Auburn, N. Y.*, (191 m.) for shipment, via Southern Central R R. in connection with Pa. and N. Y. R.R. 2 41

From *Lackawanna Junction* to ‖*Weedsport* (201 m.), for *Rochester and Charlotte and Erie Canal* 2 47

From *Lackawanna Junction* to *Sterling* for *Oswego, N.Y.* .. 2 50

‖ To this point for all places between Rochester and Buffalo the rate is 2 53

* The rate to this point for Syracuse is 2 08

** Rates on line coal from Hazleton are 10c. per ton above these figures.

‡ The cost of unloading is to be added to these rates. No charge less than 40c. per ton will be made for any distance. Tolls from Mauch Chunk to Phillipsburg for way points will be $1 15 per ton.

§ Twenty cents per ton less when five cars at a time to one party. Provided that where the reduction makes the rate $1 a ton, or less, the rate will be $1.

† Transportation on Coal destined for re-shipment from this point is 20c. less than above rate.

†† The rate for consumption to this point is $1 80.

The distances in the above table are Computed from *Mauch Chunk*. From *Ashley* to *Mauch Chunk* the distance is 51 miles, and from *upper Lehigh*, 33 miles. From *Hazleton* 24 miles, and from *Penn Haven* 8 miles.

From *Wilkes-Barre* to *Perth Amboy* via the Lehigh Valley Railroad Company, the distance is 161 miles, and from *Mauch Chunk* it amounts to 106 miles.

Freights on Bituminous Coals from the Mines to Tide Water Shipping Ports.

From the Mines to Cumberland and State Line (say an average of 20 miles), the legal charge is 2 cents per ton of 2240 lb. per mile.

From State Line to Amboy (346 miles) $4 per ton of 2000 lb. On coal shipped beyond this point there is a drawback of 75 cents per net ton.

From Cumberland to Baltimore (178 miles) $2.02 per ton o 2240 lb., or $1.80 per net ton (¼ cent per ton per mile for use of hoppers over C. & P. RR.).

From Cumberland to Georgetown (152 miles) by canal, $1.10. Tolls, 46 cents.

From the Mines to Piedmont, 4 cents per ton of 2240 lb. per mile on distances less than 4 miles, and 3 cents per ton per mile on distances over 4 miles, and 2 cents per ton per mile on distances over 10 miles.

From Piedmont to Baltimore (206 miles) $2.34 per ton of 2240 lb., or $2.08 per net ton.

From Osceola to Greenwich, Phila. (say 248 miles) per T. & C. RR, per ton bituminous coal of 2000 lb., less drawback of $1 $2.15; rate per gross ton, $2.60.

From Osceola to South Amboy, N.J., (317 miles) per 2000 lb., $4.03, less drawback, $1.03; rate per net ton, $3; add 12 per cent. for gross ton, 36 cents, terminal expenses, shipping, 20 cents; rate per gross ton, $3.56.

IRON MARKET REVIEW.

New York.

[FRIDAY EVENING, June 30, 1876.

American Pig.—We are reported sales of 600 tons of No. 2 foundry iron on private terms, and 2,000 tons of Port Oram forge, and No. 2 foundry at $19.25. Business continues quite dull, and prices are without change, excepting for forge, which, owing to its scarcity, is higher. We quote No. 1 foundry at $22; No. 2, at $20; and forge at $19.50@$20.

Scotch Pig.—This article is very quiet, and without features worthy of note. We quote Eglinton at $27@$28; Coltness, $30; and Glengarnock at $28@$29.

Messrs. JOHN E. SWAN & BROTHERS (Limited), of Glasgow, under date of June 16, report 116 furnaces in blast as against 122 a year previous; 63,523 tons of pig iron (an increase of 335 tons during the week) in CONNAL & Co's stores, against 36,358 tons at the corresponding period of 1875; shipments for the week ending June 10, 10,330 tons, as compared with 11,625 tons during the corresponding week of last year; total decrease of shipments since Dec. 25, as compared with the same period in 1874-5, 34,310 tons; quotations of No. 1 iron as follows: Gartsherrie, 64/6; Coltness, 68/6; Summerlee, 61/6; Langloan, 67/; Glengarnock, 63/; and Eglinton, 57/; quotations of freights as follows: to New York, 3/6; Boston, 9/; New Orleans, /5; Baltimore, 8/; Philadelphia, 10/; and San Francisco, 27/6.

Rails.—We are reported sales of a lot of 2,500 tons, and another of 1,500 tons, particulars not given. There is some inquiry, and further business is anticipated during next week. We quote iron rails at mills at $39@$42; and steel at $58@$63.

Old Rails.—We are reported sales aggregating 500 tons at $20@$21, and 700 tons on private terms. We quote at $21@$22.

Scrap.—We learn of no sales of wrought, and continue to quote at $28. We are reported a sale of 600 tons of old car wheels at $19.50@$20.

Baltimore. June 28, 1876.

Specially reported by Messrs. R. C. HOFFMAN & Co.

We have no change to report in the iron market since our last. Sales at quotations:

Baltimore Charcoal	$30@35	Anthracite No. 3 ..	$20@21 00
Virginia Charcoal	28@34	Mottled and White	17@19 00
Anthracite No. 1	23@24	Charcoal C B.Blooms	65@57 50
" No. 2	21@22	Refined Blooms	50@55

Boston. June 26, 1876.

PIG continues along in a stupid way, holders taking pretty nearly what buyers offer, but selling very little. There is in fact a slight view of improvement in the tone of the market more especially noticeable in holders being unwilling to sell more than five or eight-ton lots at the prices, while here and there a small advance is asked.

BAR has a quiet jobbing trade at from $51 to $55 according to order and character of buyer. The improved tone last noted is upheld, while the advices from the West are more uniformly favorable for a steadier market.—*Commercial Bulletin.*

Chattanooga, Tenn. June 27, 1876.

Specially reported by J. F. JAMES. pig iron broker, etc., 233 Market Street.

The market here is dull and prices unchanged, with little or no prospect for improvement. Holders of outside lots are restricting sales to be made for spot cash.

The usual four months is given on quotations below:

Tenn. Ala. and Ga. Charcoal,	No. 1 foundry	$21@ 22	
" " " "	No. 2 foundry	20@ 21	
" " " "	gray forge	17@ 18	
" and Georgia coke,	No. 1 foundry	18@ 19	
" " " "	No. 2 foundry	17@ 18	
" " " "	gray forge	15@ 16	
White and Mottled		14@ —	
Tennessee and Georgia cold-blast car wheel		24@ 25	
Alabama " "		24@ 25	
Old Rails		cash 22 00	
Cast Scrap		" 12	
Wrought Scrap		" 16	

Cincinnati. June 27, 1876.

Specially reported by Messrs. TRABER & AUBERT, commission merchants for the sale of pig iron, blooms, ore, etc.

We have no change to report in our pig iron market.

CHARCOAL.

Hanging Rock, No. 1 Foundry	$25 00@	—4 mos
" No 2, "	23 00@	—4 mos
" Mill	22 00@	—4 mos
Tennessee, No. 1, Foundry	23 00@24 00	—4 mos
Tennessee, No. 2, "	22 00@23 00	—4 mos
" Mill	21 00@	—4 mos
Missouri, No. 1, Foundry	@	—4 mos

STONE COAL.

Ohio, No. 1, Foundry	23 00@	—4 mos
" No. 2, "	21 00@22 00	—4 mos
Ohio Mill	20 00@	—4 mos
Missouri, No. 1 Foundry	26 00@	—4 mos
" No. 2, "	24 00@	—4 mos
" Mill	23 00@	—4 mos

CAR-WHEEL.

Hanging Rock, C. B	40 00@45 00	—4 mos
Tennessee "	28 00@32 00	—4 mos
Missouri "	33 00@35 00	—4 mos
Alabama "	28 00@32 00	—4 mos

BLOOMS.

Charcoal	60 00@ 75 00	—cash

SCRAP IRON.

Cast	50c.@ 85	—cash
Wrought	1 00@1 35	—cash

Cleveland, Ohio. June 27, 1876.

Messrs. C. E. BINGHAM & Co., quote as follows:

Per gross ton, on four months' time. Subject to change in market. Discount for cash 4 per cent.

FOUNDRY IRON.

No. 1, Lake Superior Charcoal	27 00@....
No. 2, " " "	26 50@....
No. 1, Anthracite	25 50@....
No 2, "	23 00@....
No. 1, Bituminous	25 00@ ...
No. 2, "	23 00@....
American Scotch, No. 1, Cherry Valley	27 00@....
" " B—1, " "	26 00@....
" " No. 2, " "	24 00@....
No. 1, Massillon	26 50@....
B—1, "	25 00@ ...
No. 2, "	22 00@....

CAR WHEEL AND MALLEABLE IRON.

No. 3 Lake Superior Charcoal	27 50@....
No. 4 " " "	27 50@....
Nos. 5 and 6 "	27 50@....

BESSEMER IRON.

Nos. 1 and 2 Lake Superior Charcoal	27 00@....

FORGE IRON.

No. 1, Gray	22 00@....
White and Mottled	20 50@....

Louisville. June 27, 1876.

Specially reported by Messrs. GEORGE H. HULL & Co.

Our market remains about the same. Demand for foundry and mill grades is dull, as it might be expected at this season of the year. With the opening up of the stove foundries we look for a somewhat better demand, and should the mills resume active operations, we think that with the limited supply of good forge irons in stock would have a strong tendency to stiffen prices somewhat.

The usual time, four mos., is allowed on the quotations below:

HOT BLAST—CHARCOAL.

No. 1 Foundry, from Hanging Rock Ores	$24 00@26 00
No. 2 " " "	22 00@23 00
No. 1, Mill, from " "	20 00@21 00
No. 1. Foundry, from Alabama, Georgia and Tennessee ores	22 00@23 00
No. 2, Foundry, from Ala., Geor'a and Tenn. ores	21 00@22 00
No. 1, Mill, from " " " "	20 00@21 00

HOT BLAST—STONE COAL AND COKE.

No. 1, Foundry, from Hanging Rock Ores	22 00@23 00
No. 2, " " " "	21 00@22 00
No. 1, Mill, " " " "	20 00@21 00
No. 1, Foundry, from Ala. Ga. and Tenn. Ores.	22 00@23 00
No. 2, " " " "	20 00@21 00
No. 1, Mill, " " " "	19 00@20 00
No. 1 Foundry, from Missouri Ores	—— @ ——
No. 2 " " " "	—— @ ——
No. 1 Mill, from Missouri Ores	24 00@25 00

COLD BLAST—CHARCOAL.

Car Wheel from Hanging Rock Ores	35 00@40 00
" " Tennessee "	28 00@30 00
" " Alabama and Georgia Ores	28 00@38 00
" " Kentucky Ores	28 00@38 00

Milwaukee. June 20, 1876.

Iron remains much the same—sales small.

per ton of 2,240 lb.

Frankfort L. S. Charcoal,	No. 1	$28 00
" " "	No. 2	27 00
" " "	No. 3, 4 & 5	25 00
" " "	No. 6	25 00
Mil. Anthracite L. S.,	No. 1	27 00
" " "	No. 2	26 00
Wisconsin Iron,	No. 1	26 00
Mahoning Valley Bit's	No. 1	32 00
" " "	No. 2	30 00

Richmond, Va. June 26, 1876.

Reported by ASA SNYDER, Esq.

Cold blast charcoal pig iron, of superior quality, can now be supplied more regularly than at any time in 1876. The stock here does not increase. Sales are effected promptly, although the transactions are light. Prices are not as firm, but quotations have not changed since last report.

There is now no Virginia anthracite for sale here.

Virginia Cold Blast Charcoal Pig Iron			$27 to $33
" Warm "	"	"	24 to 28
" " " Coke	"	" 1 X	23 to 24
" " " "	"	" 2 X	21 to 22
" " " "	"	" 3	20 to 21
" Anthracite 1 X			— to —
" " 2 X			— to —
" " 3			— to —

St. Louis. June 27, 1876.

Specially reported by Messrs. SPOONER & COLLINS, Commission Agents for all kinds of Iron.

We note no change since last report. Trade very dull. We quote same as last:

Mo. Stone Coal No. 1 Fy.	$25@26	Massillon iron, A No 1	29@30
" " " 2 "	23@24	" " B " 1	31@—
" " Gray Mill,	22½@23	" " " 2	28@—
" Charcoal No. 1, Fy.	23@24	Cold Bl. Car Wheel, Mo.	30@33
" " " 2, "	22@23	" " " " Tenn.	30@33
" " Gray Mill,	22@23	" " " " Ala.	30@33
Tenn. " No. 1, Fdy	23@24	" " " " H. R.	33@35
" " " 2, "	22@23	Mo. Charcoal Blooms	50@55
" " Gray Mill	22@23	" Scrap "	45@55
Va. Coke, No. 1, Fdy.	24@25	" " hammered Billets	75@80
" " " 2, "	23@24	Assorted Bar Iron	2 50, 60days
" "Gray Mill,	21@23	H. R. Char. No. 1, Fdy.	25@26
" " " 2, "	24@25	No. 1 Wrought Scrap	90c. cwt.
" " Gray Mill,	24@25	Heavy cast "	70 "
		Light "	50

San Francisco, Cal.

From the *Commercial Herald*, June 22, 1876.

The *Ajax* from Oregon brought us 36 tons from the Oswego Company; price, $32. From Sydney we are in receipt of 319 ingots tin per *Merchant*, and 360 ingots same per *Frith of Forth*. Our stock of pig iron continues excessive. All the different brands of Scotch and English may be quoted within the range of $30@32.50. Tin plate, bar iron, and in fact all other goods in the line, move off very sluggishly.

Montreal. June 13, 1876.

We continue to quote: Pig iron Eglinton and Clyde $19@20.00; Carnbroe $20 00@21 00; American $22@24; Summerlie and Calder $20@21; Langloan and Gartsherrie $21@22; Coltness $21.50@22.00; Hematite $27@28. Bar, per 100 lb., Scotch and Staffordshire, $2.15@2.25; best do., $2.45@2.55. Swedes and Norway $5@5.50; Low Moor and Bowling, $6.50@7—*Monetary Times.*

METALS.

NEW YORK, FRIDAY EVENING, June 30, 1876.

THERE is but very little doing in any article on this list. Business will be generally suspended to-morrow night and not resumed until July 5th, and it is doubtful if much will be done during the whole of next week.

Gold Coin.—During the week under review gold has ranged from 111⅛@112⅜, and closed at 112⅜.

Bullion.—A great decline has taken place in silver, and quotations are lower than ever before. By cable, to-day, we learn that the London market has declined to 49½d., in anticipation of the probable low rates at which an India Loan will be offered next week, and partly in consequence of the offer by cable from this side of several California lots, purchased here yesterday. Any lot of magnitude offered in the London market suffices to depress prices ½ to 1 per cent., such is their extreme weakness. Prices here are very irregular, the quotations given us ranging from $106@$110, while the San Francisco market has declined to 15 per cent. discount. Gold bars are unchanged in price.

Copper.—The sales during the week have aggregated about 200,000 lb. at 19¼@19¼c. The market closes at 19¼c.@20c. This advance is caused by outside lots of copper being scarce, and the large mining companies holding firmly on their copper. At the sale of Wallaroo copper on the 27th inst., the average price secured was but £78 5/, as against £83 at the former sale. In sympathy with this great decline, Best Selected has fallen to £80 and Chili Bars to £74@£75

Tin.—There is nothing doing in pig tin which is quoted in gold as follows: Straits 17¼c.: L. & F. 17¼c.; Refined, 17¼c; and Banca, 21¼c. Cable advices to-day quote straits in London at £74 10/ and $21.25 at Singapore.

Tin Plates are very dull of sale and quoted in gold, per box, as follows: Charcoal tins, 6.75@$7.25 and ternes, $6.37½@6.62½; coke tins, $6 and ternes $5.50 @5.75.

MESSRS. ROBERT CROOKS & Co. of Liverpool, under date June 15 says of Tin Plates: "The aspect of this trade has not altered materially since our last advices. Some exceptionally low sales have been made, but only by a few makers, the majority declining offers of round quantities at a small reduction off their quotation. Several large works have carried into effect their assertion that they would close if things did not improve, and this course is in the direction of firmness, and it is consequently most important now to watch very closely the action of the larger buyers, as on this prices must largely turn."

Lead.—The business in this article has been very limited at 6·35c.@6¼c.

Spelter and Zinc.—Domestic spelter is very quiet. The Combination continues to hold at 8c. currency, usual terms, although outside lots are offering as low as 7¼c. Sheet zinc is dull at 8¼@8¾c gold.

Antimony.—is quiet at 15¼c. gold.

Quicksilver shows a further decline, and is quoted at £8 15/ per flask in London; 53c.@54c. per lb. here; and 47½c.@49c. in San Francisco.

The San Francisco *Commercial Herald* of June 22 says: The *Colima*, for Panama, carried en route for New York 100 flasks; the same, to Mexican ports, 300 flasks. Pending the departure of the China steamer for Hong-Kong on the 1st of July, stocks are steadily accumulating, with little inquiry. The shipments overland in May by Central Pacific were in gross weight 52,248 lbs. The *Gaelic* for Hongkong on the 16inst., carried 946 flasks, and to Japan 25 flasks. The present price is 49@50c. but for prompt cash it can be bought for less. The *City of Sydney* carried for Australia 185 flasks.

FINANCIAL.

New York Stocks.

FRIDAY EVENING, June 30, 1876.

This market has been fairly active during the week, the transactions aggregating 37,264 shares, a decrease of about 16,000 shares, compared with the extensive sales recorded in our last. The quotations, however, continue downward, the whole list with but a single exception, closing at lower prices.

New Jersey Central Railroad.—Stock is lower by 2½ per cent., with a slight decrease in the sales, 24,222 shares representing the total. The fluctuations have been from 71 to 75¼, closing price 73.

Delaware, Lackawanna, and Western Railroad.—Stock is 1 per cent. higher, with sales of about 7,000 shares for the week.

Delaware and Hudson Canal Company is ¾ per cent. lower, the sales amounting to only about 800 shares. 2 per cent. represents the fluctuations in this stock for the week, with a slight recovery at the close.

Consolidation Coal Company.—2,000 shares of this stock was sold principally at $40, a decline of ¼ per cent. from our last.

Mariposa Land and Mining Company exhibits quite an advance, with sales of 3.550 shares for the week. A telegram from the tunnel reports that the daily ore yield from the south drift on the vein is ten tons, valued at $18 to $25 per ton. The pay seam is said to be three feet wide.

Utica, Ithaca, and Elmira Railroad.—This road has laid a switch to connect that road with the Delaware, Lackawanna, and Western Railroad at Courtland, so that both roads now, being of the same gauge, cars can be changed from one to the other.

Cape Breton Railroad.—It is stated that work will soon be resumed on this road which is to connect the coal mines on Cape Breton Island with the Port of Louisburg. The Louisburg railroad lands, heretofore held in trust, have been transferred to the railroad company.

The Denver and Rio Grande Railroad is completed and running to a point seventy-four miles from the San Juan gold region, by the Fort Garland route.

From advance sheets of *Poor's Manual of Railroads* we learn that the total miles of railroads whose operations are reported for 1875 was 71,759, and the total earnings were $503,065,505, against $520,466,016 for 1874, decrease of $17,400,511. This decrease is almost entirely confined to freight receipts, which have fallen from $379,466,935 in 1874 to $363,960,234 in 1875. The quantity of freight moved has not diminished, but the low rates that have prevailed have reduced the earnings. The net results, however, almost equal those for 1874, and surpass those for any other former year, being $185,506,438, against $189,570 958 for 1874. This shows a great reduction in operating expenses, and is a move in the right direction. The dividends paid were $74,294,208, an increase over 1874 of $7,251,266.

The July disbursements for interest and dividends at New York are estimated at $50,000,000, and at Boston over $9,000,000. These heavy payments must add materially to the large supply of unoccupied money on the market. A very large amount of these interest payments and dividends will naturally seek reinvestment, and as there is more than the usual disposition evinced on the part of investors to buy only what is undoubtedly reliable, a further advance of what already seems to be high prices of such securities is not improbable. One of the effects of this close discrimination in favor of the safe and reliable, will be to bring the income from investments down to, and, probably, within the rate of six per cent. Those bonds and shares that pay high rates, if really good, will sell at prices that bring the annual interest on their cost down to about the legal rate.

The Wyandotte Rolling Mill Company will hold a special meeting at the office in Detroit, Mich., July 13. The call for the meeting says: "Matters of importance will be laid before the meeting, including the expediency of some improvements to the property, of a reorganization, providing a larger working capital, and for funding the bonded indebtedness becoming due within the next three years."

Coupons and Interest is due on the following during the month of July.

Albany and Susquehanna Railroad, 1st mtg'e bonds, coupons.

American Dock and Improvement Company, coupons.

Baltimore and Ohio Railroad.—Interest on preferred stock and coupons, on the bonds of 1880.

Boston, Hartford, and Erie Railroad.—Coupons.

Cannelton Coal Company.—Gold and currency coupons.

Central Railroad of New Jersey.—Interest on the 1st mtg'e consolidated bonds.

Chesapeake and Ohio Canal Company.—Coupons payable in Baltimore.

Chesapeake and Ohio Railroad.—Interest on the gold and currency bonds of this company, will be due in July.

Consolidation Coal Company.—Coupons on the 7 per cent., and also on the convertible bonds.

Crown Point Iron Company.—Coupons.

Cumberland Coal and Iron Company.—Coupons on the 1st mtg'e bonds.

Delaware and Hudson Canal Company.—Interest on the 1st mtg'e reg. bonds of 1884 and 1891.

Eureka Coal Company.—Interest.

Evansville and Crawfordsville Railroad.—Coupons.

Grand Tower Mining and Manufacturing Company.—Coupons.

Holliday Coal Company.—Coupons.

Mahoning Coal Railroad Company.—Coupons.

Maple Grove Coal Company.—Coupons.

Milwaukee Iron Company.—Coupons.

Monongahela Navigation Company.—Coupons.

Morris and Essex Railroad.—Coupons on bonds due in 1900, and interest in 1st mtg'e bonds.

Newark and New York Railroad.—Coupons.

Peytona Cannel Coal Company.—Interest.

Quicksilver Mining Company.—Coupons.

Straitsville Cannel Coal Company.—Interest.

Swedes Iron Company.—Coupons.

Thomas Iron Company.—Interest.

Union Pacific Railroad.—Coupons on the 1st mortgage gold bonds, also on the southern branch bonds. On $30 coupons two-thirds will be paid in gold, the remaining one-third to be funded.

Union Coal Company.—Coupons.

United New Jersey Railroad and Canal Company.—Coupons.

Glendon Iron Company. This Company will pay a dividend of 3 per cent. in Boston on July 1st.

The Moingona Coal Company of Boston has its dividend period during July.

The Albany and Susquehanna Railroad Company announces a dividend of 3½ per cent. payable July 1st.

Quotations and Sales of Stocks and Bonds.

For the week ending June 30, 1876.

STOCKS.

	Highest	Lowest	Closing	Shares sold.
Pennsylvania Coal Co	—	—	—	—
Consolidation Coal Co	40½	40	40	2000
Spring Mt. Coal Co	—	—	*53½	200
American Coal Co	—	—	*54	—
Maryland Coal Co	—	—	*12½	—
Del., Lack., and West. RR. Co.	108	104⅛	107⅝	6611
New Jersey Central RR. Co.	75⅛	71	71⅞	24222
Delaware and Hudson Canal Co.	107½	105¼	105⅝	781
Quicksilver Mining Co. pref'd	—	—	—	—
" " Common	14½	14	14	100
Mariposa Land & Min. Co. pref'd	11	9	10	3550
St. Louis & Iron Mountain RR.	—	—	17	—
Lehigh & Wilkes-Barre Coal Co.	—	—	—	—
Total Shares sold				37464
Sales for the week previous				53645
Decrease				16181

* Nominal.

BONDS.

	Inter'st	Sales.	Price.
Del., Lack. & West. 2d M	M. & S.	.....	.... @ ....
" " " 7's Con'ble	J. & D.	..	.... @ ....
Cent'l RR. of N.J., 1st M, New	F. & A.	7,000	.... @112
" " " 1st Cons	.. ...	.....	.... @ ....
" " " Convert'le	M. & N.	18,000	.. @100
Lehigh & W.-B'e, Con. Guar'd.	.....	41,000	81 @ 90
Am. Dock & Imp. Mt. Bonds..	J. & J.	15,000	100¾@101¼
Del. & Hud. Can., 1st M., 1891	.....	....	.... @ ....
" " " 1884	.. ....	2,000	.... @110
" " " 1877	.....	.....	.... @ ....
" " " Coup. 7's, 1894	.....	.....	.... @ ....
" " " Reg'd 7's, 1804	.....	.....	.... @ ....
St. L. & Iron Mountain, 1st M	F. & A	.....	.... @ ....
" " " 2d M	M. & N	.. ...	.... @*79
Chesapeake & Ohio 6's, 1st M	.....	†2,500	28 @ 28¾
" " Ex. Coupon	.....	.....	.... @ ....
Total sales	.....	$85,500	

* Nominal.

† $500 of these Bonds "small" sold for 25.

Philadelphia Stocks.

PHILADELPHIA, Thursday Evening, June 29, 1876.

The Coal carrying shares in this market are beginning to feel the effects of the decline in tonnages, the list showing a fall in prices ranging from ⅛ to 2½ for the week with an increase of some 12,000 shares in the transactions.

Lehigh Valley Railroad Company. This stock has exhibited considerable activity during the week, the sales amounting to nearly 3,000 shares, and the quotation closing at a decline of 2½.

Pennsylvania Railroad Company's stock has sold to the amount of over 25,000 shares and is the least affected of any item in the list, the closing quotation showing only a decline of ⅛. The very large increase in the earnings from the passenger traffic on this road no doubt contributes to the comparative firmness in the stock.

Philadelphia and Reading Railroad, closed ¼ lower with sales aggregating nearly 15,000 shares for the week an increase of some 7,000 shares compared with the transactions reported in our issuse of the 24 ult.

Lehigh Coal and Navigation Company. This Stock is lower by 1⅛ with a slight increase in the transactions about 5,000 shares representing the total amount.

Bonds are generally unchanged in the quotations. We note quite a decline in the sales.

Little Schuylkill Navigation and Railroad Company—The dividend period of this company will occur during July.

Minehill Railroad Company.—The dividend period of this company will occur during July.

The Schuylkill Navigation Company has its dividend period in July.

Buck Mountain Coal Company.—This company has its dividend period in July.

The Fulton Coal Company has its dividend period during July.

Nescopec Coal Company.—The quarterly dividend period of this company will occur on the first proximo.

The Emaus Iron Company has its dividend period on the 1st of July.

Coupons and Interest is due on the bonds of the following during the month of July:

Allegheny Valley Railroad Co., interest on the bonds issued to the State of Pennsylvania; also, Coupons on the general mortgage bonds, and on the seven and three-tenths bonds due in 1876.

Lehigh Coal and Navigation Co.—Interest on the six per cent. 1884 registered bonds.

Lykens Valley Coal Co.—Coupons.

Pennsylvania Railroad Co.—Coupons.

Pennsylvania Canal Co—Coupons on first, and also on the general mortgage bonds.

Philadelphia and Reading Railroad Co.—Coupons.

Philadelphia and Erie Railroad Co.—Coupons.

Reading Coal and Iron Co.—Coupons.

Schuylkill Navigation Co.—Interest on second mortgage loan of 1882; and Coupons of the six per cent. mortgage bonds of 1895; also Coupons of 1918 and 1902.

Shamokin Valley and Pottsville Railroad Co.—Coupons on the seven per cent. gold bonds due in 1901.

Summit Branch Railroad Co.—Coupons.

Susquehanna Coal Co.—Coupons.

Ithaca and Athens Railroad Co.—Coupons on the first mortgage seven per cent. gold bonds.

Delaware Division Canal Co.—Six per cent. bonds due in 1878, Coupons.

Chesapeake and Delaware Canal Co.—Registered sixes due in 1882, Interest.

Quotations and Sales of Stocks and Bonds.

For the week ending June 29, 1876.

STOCKS.

	Highest	Lowest	Closing	Shr's
Lehigh Valley RR. Co	58⅞	56¼	56¾	2734
Pennsylvania RR.	52⅞	52⅜	52½	25098
Reading RR.	44⅜	44⅜	44⅛	14790
Lehigh Coal and Nav. Co	46⅛	44⅜	44⅞	5097
Penn. Canal	—	—	*9	—
Buck Mountain Coal Co.	—	—	*25	—
Fulton Coal Co.	—	—	*3½	—
Locust Mountain Coal Co	—	—	—	—
Westmoreland Coal Co	—	—	75	—
St. Nicholas Coal Co.	—	—	*1	—
Cambria Iron Co.	—	—	15¾	—
Crane Iron Co.	—	—	*25	—
Emaus Iron Co	—	—	—	—
Pennsylvania Salt Manufact. Co.	70	69	69	24

Total shares sold 47,743
Sales for the week previous 35,664
Increase 12,097

* These quotations are nominal.

BONDS.

	Sales.	Price
H. and B. T. RR. 1st mortgage, 78	—	@107
" " " 2d " "	2,000	@106
" " " 3d " cons	—	@ 43
Lehigh Valley RR. Con. mtg. 6s, cou	7,000	105¾@107
" " " 7s, 1910	—	@111
" " " 6s Reg.	—	@107
" " " C. M. 6s 1923	21,000	@ 99
Pennsylvania RR., 1st mtge. 6s	3,000	@107
" " gen. " cou. 1910	7,000	@106
" " gen. " 6s, reg.	—	@106
" " Cons. M. 6s reg.	—	@ 98
Phil. & Reading RR. 7s '93	—	@107
" " G. M. 7s, reg.	—	@104
" " " 7s cou.	5,000	107 @107¼
" " new convertible 7s	—	@100¼
" " 6s '44-'80	—	@—
Phil. & Reading C. & I. Co. Deb. 7s	—	@—
" " Locust Int. tract	—	@—
Lehigh Coal & Nav. Co., 6s '84	650	102½@103
" " " RR. 6s, '97	600	@103½
" " " cov m. 7s	—	@—
" " " 6s gold loan	2,500	103½@104
Penn. Canal, 6s	1,000	@ 75½
Penn. and N. Y. Canal, 7s	—	@107½
Ches. and Del. Canal, 6s	—	@—
Susquehanna Canal, 6s	—	@ 77
Delaware Division Canal, 6s	—	@—
Susquehanna Coal Co. 6s	5,000	@ 77
Buck. Mount Coal Co. 6s	—	@—
Penn. Gas Coal Co. 6s	—	@—
Honeybrook Coal Co. 7s	—	@—

Total amount of sales $54,750

Closing quotations, in the absence of sales, represent the latest prices bid.

Gold and Silver Stocks.

NEW YORK, FRIDAY EVENING, June 30, 1876.

The dealing in Gold and Silver Stocks, as reported by telegraph from San Francisco, has been without notable feature during the past week. The warm weather and absence from the city of many of the heavy operators, have contributed to make the market steady. The Comstock mines continue to send out large amounts of the precious metals, and, so far as outsiders are allowed to know anything of the actual condition of the mines, there is every prospect of the bonanza holding out for some time yet, though it has evidently passed its prime in the Consolidated Virginia, and hat mine seems to have reached the ebb of its tide of prosperity. The California, which has only recently commenced wo king on a large scale has now gone far ahead of Consolidated Virginia, the stock of the former being quoted 72 and of the latter 57. The Consolidated Virginia Company on the 10th inst. paid the county assessment on its bullion product for the quarter ending March 31st the sum of $130,265.46, or at the rate of over half a million a year. The new 80 stamp mill of this company is being completed with all possible dispatch, and when running will add largely to the product and profits of the company. The west drift on the 1,500-feet level is driven at the remarkable rate of 70 feet a week.

The California yields some 350 tons of ore a day, and the mine is said to be looking very well. The crosscuts on the 1,600 level are promising very rich ore. A considerable quanity of ore is being extracted through the Ophir shaft, and generally the prospects of the California are very brilliant.

Hale and Norcross.—The new pumping machinery is being erected with the energy characteristic of bonanza mines.

In *Yellow Jacket* exploration works are pushing ahead, some drifts being in fair ore, but not bonanza.

Generally, the gold and silver mines of the West are doing remarkably well, and the product gives every indication of being largely increased this year over last. A number of the Bonanza Kings have come East to the Exhibition, and have since visited gold mines in North Carolina, Virginia, and other mining property East. Let us hope they will devote some of their countless millions to developing Eastern mines, some of which offer inducements not excelled by the Comstock.

Our cable advices from London, to-day, quoting silver at 49⅛ pence and very weak—the decline being partly due to the sale of some California lots—is far from encouraging to the owners of silver mines. We are quoted $1.06 here. There is no indication that the bottom has yet been reached in silver, and we would not be surprised to have to quote considerably lower figures yet. The effect of this upon silver stocks must be apparent to every one.

QUOTATIONS:

	No. of feet on Vein.	No. of shares.	June 22.	June 29.
Sierra Nevada	3,300	100,000	$11	$14
Union Consol'd.	600	100,000	11	11
Mexican	600	108,000	28	28
Ophir	675	108,000	50	50
California	600	540,000	74	73
Consol'd. Virginia	710	540,000	60	58
Best & Belcher	540	100,800	48	46
Gould & Curry	612	100,800	14	15
Savage	771	112,000	18	19
Hale & Norcross	400	112,000	*9	9
Chollar Potosi	1,400	28,000	78	75
Alpha Consol'd	306	30,000	47	47
Imperial Con.	468	500,000	6	6
Yellow Jacket	957	120,000	32	31
Kentuck	95	30,000	12	12
Crown Point	541	100,000	10	10
Belcher	1,040	104,000	17	17
Overman	1,200	38,400	59	57
Caledonia	2,188	100,000	8	8
Justice	2,100	105,000	22	22
Raymond & Ely	5,000	30,000	8	9
Meadow Valley	4,400	60,000	1	1
Eureka Consolid.		50,000	11	12
Eureka G. V.	1,680	20,000	3	3
Silver Hill	5,400	54,000	7	7
Julia	3,000	110,000	9	9

*Shares increased June 19, 7 for 1.

Copper Stocks.

Specially reported by Messrs. WILSON W. FAY & Co., Bankers and Brokers, Room 7 Traveller Building, 31 State Street, Boston.

BOSTON, THURSDAY EVENING, June 29, 1876.

We have no change to report in the condition of the copper market for the week ending to-night. Allouez $11 bid, and nothing doing in it. Calumet very steady at 164¼, all the sales being at that figure. Central is stronger at $32 bid, an advance of $2 per share. Copper Falls is stronger at $3.50, bid, no stock offering under $4. The company gives notice that on all assessments paid in by July 1, no interest will be charged, otherwise interest will be charged from May 25. Franklin steady at 97½ bid. Quincy offered at $43. In small coppers, nothing.

At the special meeting of the Superior Mining Company, held June 27, the following ticket was presented for election: WILSON W. FAY, J. BAIRD, WM. REED, J. R. GLEASON, GEO. W. MAY, and Mr. HOYT, of Michigan; but as only 9,300 shares voted, the President declared the election void, and dissolved the meeting. There is some question as to the right of the President in his decision, and a call for another meeting has been made.

Sales for the week have been as follows: Duncan Silver, 100 shares at $1.25 per share; Calumet & Hecla, 27 shares at $164.50 per share; Quincy, 20 shares at $43 per share; Copper Falls, 25 shares at $3.87½ per share.

DESCRIPTION.	Par Value.	No. of Shares.	CLOSING. Bid.	Asked.
Allouez	$50	20,000	$11 00	$12 00
Calumet and Hecla	25	80,000	164 00	164 50
Central	25	20,000	32 00	33 00
Copper Falls	50	20,000	3 50	4 00
Dana	25	20,000	8	12½
Franklin	25	20,000	9 50	10 00
Humboldt	25	20,000	9	11
Madisca	25	20,000	27	30
Mesnard	25	20,000	45	50
Minnesota	25	20,000	1 50	2 00
National	15	20,000	1 12½	1 25
Osceola	25	40,000	21 00	22 00
Petherick	25	20,000	50	55
Pewabic	25	20,000	3 00	3 87½
Phenix	25	20,000	—	—
Quincy	25	20,000	42 50	43 00
Ridge	25	20,000	4 62½	5 00
Rockland	25	20,000	28	32
International Silver	20	60,000	9	11
Star	25	20,000	40	50
Superior	25	20,000	8	12½
Duncan Silver*	20	60,000	1 12½	1 25

*Assessment paid.

Gas Stocks.

NEW YORK, FRIDAY EVENING, June 30, 1876.

The market for gas stocks seems to be stationary, no demand and consequently no transactions. We hear of no sales worthy of record, and no doubt a marked concession could be obtained from any quotations in our list, in a transfer of any importance.

Manhattan Gas Company's stock is lower; the company has declared a cash dividend of 5 per cent., payable to-morrow, the 1st prox.

New York Gas Company.—We note an improvement in this stock of $5 per share in the quotations bid, and offered, no transactions are reported, however.

National Gas Company.—This company has declared a quarterly dividend of 5 per cent., payable in Philadelphia to-morrow, the 1st prox.

The Providence, R. I., Gas Company announces a dividend of $2.50 per share, payable July 1st.

Coupons and Interest are due on the following during July:

Champaign and Urbana, Ill., Gas Company.—Coupons.

Lawrence, Mass., Gas, Coke and Coal Company.—Coupons.

Milwaukee Gas Light Company.—Coupons.

Omaha Gas Company.—Coupons.

The Northern Liberties Gas Company has its dividend period during the month of July.

The following list of Companies in New York and vicinity are corrected weekly by GEORGE H PRENTISS, Broker and Dealer in Gas Stocks, No. 30 Broad st., N. Y.

Quotations "bid" and "asked" of New York City and Vicinity Gas Companies are on the $100 of stock and not on one share.

Companies in New York and Vicinity	Cap. Stk.	Par.	last Dividend.	When Paid.	Bid.	Askd.
			pr.c			
Mutual, N. Y.	$5,000,000	$ 100	2½	Jan. '76	114	114½
" " Bonds	900,00	1,000	†3½	Feb. '76	105	
NewYork, "	4,000,000		5	Jan. '76	135	140
Metropol. "	2,500,000	100	5	Mar. '76	145	147½
" " Certf.	1,000,000	...	3½	"	103½	
" " Bonds	500,00	1,000	3½	Jan. "	102	102½
Harlem "	1,850,000	50	4	Feb. '76	118	122
Manhattan "	4,000,000	50	10	July "	235	240
Brooklyn, B'klyn	2,000,000	25	5	June '76	185	195
Nassau "	1,000,000	25	4	Jan. '76	75	80
" " Certf.	700,000	1,000	3½	Nov. '76	94	95
People's "	1,000,000	10	3½	Jan. '76	45	50
" " Certf.	300,000	1,000	3½	Jan. '76	85	87½
" " Bds	325,000	....	3½	Feb. "		95
Metropol. "	1,000,000	10	3½	Nov. '75	70	75
Wmsburgh "	1,000,000	50	5	Jan. '76	122	130
" " Certf.	1,000,000	....	3½	Jan. "	100	102
Citizen's "	1,200,000	20	2½	Jan. '76	88	90
" " Certf.	320,000	1,000	3½	April "	99	101
J. C. N.J.	386,000	20	5	July, '75	160	170
Centl. Westch. N.Y.	466,000	50	4	July, "	95	100
Subur'n " "	390,000	50				95

† Gold.

Companies out of Town.*	Cap. Stk.	Par	Bid	Askd
People's " " of J. C.			120	133
¶Citizen's G. L. Co., New'k, N.J.	1,095,000	50	85	90
Perth Amboy G. L. Co., N. J.		25		95
Hempstead " " L. I., N.Y.	40,000	100		100
Jamaica, " " "	25,000	100		100
Richmond Co., S. I. "	300,000		100	105
Citizens', Rochester, "		100	45	50
Rochester Gas Co., "		100	50	
‖People's G. L. Co. Albany, "	1,000,000	100		25
§Mutual " Buffalo "	750,000	100	48	55
Mutual " Detroit, Mich.		50	18	
TroyG. L. Co., Troy, N. Y.			108	
Citizens " " "	600,000	100		100
Brockport, N. Y., G. L. Co.	25,000	100	60	80
Saugerties G. L. Co.	15,000	100	100	115
†Baltimore G. L. Co., Balt., Md	2,000,000	100	155	1 65
St. Louis G. L. Co., St. Louis, Mo	600,000		110	130
People's G. L. Co., Balt., Md	2,000,000	25	24½	25⅞
Hannibal G. L. Co., Hanni., Mo,	100,000	100	95	100
La Clede, St. Louis, Mo	1,200,000	100		102
Lewiston G. L. Co., Lewis., Me	400,000	100	50	85
Chicago G. L. Co., Chicago, Ill.	2,000,000	100	125⅛	
Jacksonville, Ill.	120,000	100	82	
‡Lima, Ohio.	60,000	100	10	
Derby G. L. Co., Derby, Conn.	160,000	100	60	80
Woonskt G. L. Co. Woonskt, R.I.	150,000	100	100	
Fort Wayne G. L. Co. F. W., Ind		100	90	100
North. Liberties G. L. Co. Phila.		25	29	
Wilkes-Barre G. L. Co W. B. Pa.		50	70	
Washington G. L. Co., Phila.			42	43
Pottsville, Pa., Gas Co		50	40⅛	
Portland G. L. Co. Portland, Me	350,000	50	72	75
Hartford G. L. Co., Hartford, Ct	700,000	25	41	
Boston G. L. Co., Boston, Mass.	2,500,000	500	785	790
East Boston, Mass		25	132	
Chelsea G. L. Co. Chelsea, "	300,000		139	
Cambridge G. L. Co., Cam., "	700,000		132¾	
Louisville G. L. Co., Louis., Ky.			127	
Cincinnati G. L. Co, Cincin, O.				200
Carondelet G. L. Co., Mo.		50		6⅛
S. F. G.L. Co. San Francisco, Cal	10,000,000	100	99¾	99½
Stillwater G. L. Co., Minn.	50,000	50		26
City G. L. Co. Montreal, Can.	1,440,000	40	165	166
Consumers G. L (old.) Tor., Ont	600,000	50	133	
Hamilton G. L. Co., Ont.	150,000	40	112½	
Halifax G. L. Co., Halifax, N.S.	400,000	40		147½

* These quotations represent the latest obtainable prices at which sales were made.

† This Company has issued $1,000,000 in certificates in addition to their stock indebtedness, on which they pay interest at the rate of 6 per cent. gold.

‡ This Company has $30,000 in bonds outstanding.

§ $200,000 represents the bonded indebtedness of this Company.

‖ $350,000 of the indebtedness of this company is represented by bonds.

¶ $124,000 of the indebtedness of this company is represented by bonds; also $53,000 in certificates, which is included in the aggregate stock debt quoted.

FIRE BRICK.

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Corner Delancey street, East River. NEW YORK.

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Iron Works for Sale in Canada.

THE ATTENTION OF CAPITALISTS IS CALLED to the Sale of the extensive Rolling Mill, Forge, and Nail-factory at Montreal, and of the Property at River Moisic, consisting of 2,280 acres Land, Buildings, Iron Mine, Magnetic Iron Sand, Iron Steamer, Scows, etc., etc., all belonging to the Insolvent Estate of the Moisic Iron Company, Montreal.

For this valuable Estate, tenders will be received up to the 23d of August next, at Noon, and full information will be given by WILLIAM RFIND, Assignee,

MONTREAL, June 26, 1876. 58 St. Francis Xavier Street.